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ABSTRACT

This study is concerned with teaching in an apprenticeship setting--the architectural design studio. The research examined teachers' planning, particularly as it focuses upon project assignments. The study yielded information about teachers' conceptual frames for their teaching, the personal aspects of teaching, the teachers' conceptions of students, and the complexities of designing an effective studio assignment and then helping students through a solution. The findings about studio teachers teaching and planning form themselves into three major groupings: (1) patterns of teachers' knowledge and reflections; (2) findings about the academic task; and (3) teaching and learning as a balance of "openings" and "closings." The discussion links these themes with the existing theoretical work on teacher thinking and planning, the teachers' conceptions about the content of their subject, and academic tasks as the vehicle for learning. Explanations are offered which are applicable to other individualized teaching fields, such as apprenticeships in other professional fields, seminar instruction, and thesis advising. (JD)

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COLLEGE TEACHERS' THINKING AND PLANNING: A QUALITATIVE STUDY IN THE DESIGN STUDIO

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September 1989

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An initial overview of this study was reported at the 1987 meetings of the Rocky Mountain Educational Research Association.

Special thanks are due the two committed and eloquent design teachers who were the subjects of this research, architecture faculty members Kirby Lockard and Corky Poster. The author is grateful also to Stefinee Pinnegar (Western Michigan University) for her participation in the earlier efforts, and to Virginia Richardson (University of Arizona) for her perceptive counsel at later stages.

Abstract

This study addressed the question: "How do college teachers plan their teaching?" However, in contrast with the majority of research on college teaching, which deals with instruction and learning in more traditional formats such as lectures and small groups, this study concerned teaching in an "apprenticeship" setting -- the architectural design studio, an under-researched learning environment of immense richness and complexity. The study's theoretical base rested in recent research on teaching at both postsecondary and K-12 levels.

Because tangible task assignments provide the context in which most apprenticeship learning takes place, this research examined teachers' planning particularly as it focuses upon project assignments. Employing qualitative data from three sources, the study yielded information about teachers' conceptual frames for their teaching, the personal aspects of teaching, the teachers' conceptions of students, and the complexities of designing an effective studio assignment and then helping students through a solution. The study's conclusions discuss three final themes: teachers' knowledge and reflections, the studio problem as the academic task, and teaching as a balance between "openings" and "closings." The discussion links these three with the existing theoretical work on teacher thinking and planning, teachers' conceptions about the content of their subject, and academic tasks as the vehicle for learning. In addition to augmenting the existing research about studio teaching (of which there is little), the study offers explanations applicable to other individualized teaching such as apprenticeships in other professional fields, seminar instruction, and thesis advising.

Major Keyword Descriptors

College teaching
Teacher thinking
Instructional planning
Architectural education
Professional education

Other Keyword Descriptors

Higher education
Research on teaching
Architecture
Professional education
Individualized instruction

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Background

Research on postsecondary teaching has historically concentrated on interactive teaching, and particularly on student and teacher behavior in the classroom. Recently, however, a few researchers have turned their attention to how teachers think. As with research on the teaching of young students, this research on postsecondary teaching "assumes that what teachers do is affected by what they think. This approach ... is concerned with teachers' judgment, decision making, and planning. The study of the thinking processes of teachers ... is expected to lead to understandings of the uniquely human processes that guide and determine their behavior (Clark & Yinger, 1979, p.231). Donald (1986, 1987) has begun this process in postsecondary education by considering college teachers' conceptions of their subject matter and those conceptions' influence on their teaching. Stark and her colleagues have begun by investigating college teachers' course planning; they observe that unless researchers understand how instructors consider, select, and arrange course content we cannot hope to make the improvements called for by higher education critics and students alike (Stark, Lowther, Ryan, Bemotti, Genthon, Martens, & Haven, 1988). In all, whether for theoretical, practical, or political reasons, research on teachers' thinking is sure to reveal new insights about teaching in higher education.

Research on postsecondary teaching has also historically concentrated on traditional college instructional practices such as lectures and discussion (Dunkin, 1986), practices that account for virtually all of college-level liberal arts teaching but constitute only a portion of the instruction in professional fields. Heretofore, among the professional fields only the health sciences and the military (Dinham & Stritter, 1986; O'Neil, Anderson, & Freeman, 1986) have developed a separate, theory-based research literature about teaching. Yet enrollment in professional fields has steadily increased , and many professional faculties are growing more rapidly than are those of the arts and sciences. Clearly greater attention to instructional practices in professional fields -- and particularly the areas of instructional uniqueness in professional fields -- is warranted.

Some of the most distinctive instructional strategies in professional education occur when a significant portion of the student's education takes place not in lecture/discussion courses but in "apprenticeship" or "clinical" or "studio" teaching settings. Examples of "apprenticeship" settings would be the clinical clerkship for medical students, the senior journalism student's editorial writing course, the music major's performance course, or the design student's studio course. These courses are distinguished by the student's one-on-one relationship with the teacher, who acts in many capacities including those recently explicated by Schon (1987) and others following his lead. In the long-term study of professional education of which the current research is but one portion, one design field -- architecture -- is under study as an exemplar of design fields in which the "apprenticeship" is at the core of the curriculum.

In the literature of research on teaching in professional fields, "teaching" is defined in various ways, and is said to consist of several interrelated components, two among them being instructional planning (including at its core the teacher's conceptualization of the content area, as well as specific planning for instructional strategies and ongoing modifications of earlier plans), and instructional interaction (including many aspects of student contact, both classroom and other, both group and individual). Thus far studies of "apprentice" teaching in professional settings (Dinham, 1987a; 1987b) have concentrated on interactive instruction in the design studio, a setting in which "apprenticeship" teaching occurs both with groups and with individual

students, using strategies based both on "coaching" (Schon, 1987) and criticism (Dinham, 1986) models.

The present study moves to design instructors' thinking and planning as exemplified in apprentice teaching centering on a "project assignment." Particularly for investigating teaching in apprentice settings, it is essential that the context -- the task on which students are working -- be investigated. This effort is one of only very few studies of "mentored" or "apprentice" academic teaching, yet such teaching occurs throughout the higher education community, for example in advanced graduate instruction with term papers, with semester-long research projects, or in undergraduate or graduate thesis advising. This research is also the first work on instructional thinking and planning for the design professions.

Instructional planning is, as all teachers know, just one of the myriad aspects of teaching that cause some researchers to refer to teaching by such terms as "dilemma management" (Lampert,1985). Among the dilemmas to be managed in apprentice teaching is planning the assignment that will consume significant amounts of student time and effort. In the design studio of a typical architecture school, for example, usually a project is designed to extend for two to five weeks, or occasionally as long as an entire quarter or semester for seniors. Students spend at minimum all afternoon three days per week on the project, working nights and weekends when the due date looms. Thus, because project assignments form the context for all of the instruction in the design studio, and because they extend for such a significant period of time, the quality of these assignments' design and the skill with which teachers plan and implement these assignments are crucial to the success of students' learning. Unlike more traditional college-level instruction in which a lecture's brief maladroit example or a seminar's single awkward hour might be merely uncomfortable for teacher and student, in apprenticeships such as the design studio a poorly conceived project assignment can rob students of important learning opportunities for a significant portion of their curriculum.

In sum, then, this study of college teachers' planning represents a move from liberal arts settings to professional education, a turning from lecture/discussion in college teaching to the "apprenticeship," a focus on teacher thinking and planning rather than on interactive teaching, and a special concentration on the task of the project assignment. The design studio is used as a case exemplar for the clinical/mentor/apprentice educational settings that are central in many professional education curricula and to which this study's findings are intended to apply.

The generative questions (Strauss, 1987) stimulating this line of investigation arose from the arguments summarized above. These questions led to the research methods employed, suggested analysis methods, and guided organization of findings. The first guided the initial, descriptive study:

1. How do studio teachers teach? i.e. how do they conceive of their teaching, plan the assignment and carry out the consequent instruction? What do they think about? What principles guide their thinking? How are aspects of their thinking manifest in dealings with students?

The second question emerged as the theoretical underpinnings for the descriptive study were gathered and interwoven into the study's design. Beyond merely guiding the data collection and

interpretation, these theoretical perspectives became interesting in themselves. As a result, the following question became the study's second major research question:

2. What parallels might be found between the answers to the first question and the theoretical conceptions of others who have investigated K-12 teaching and particularly teacher thinking and planning?

Theoretical Base

Any study exploring uncharted territory inevitably enters that new territory influenced by the thinking and findings of explorers in neighboring territories. The theoretical foundations for this study emerged from several strands of recent research examining teaching: (1) the higher education literature on instructional planning, which until very recently has been extremely scattered; interesting recent conceptions about (2) how substantive content is represented, (3) how teachers view instruction, and (4) the learning task itself; and (5) the themes emerging from recent research on studio teaching. Each of these strands is introduced in the paragraphs below together with an explanation of the way they influenced the present study's design. These perspectives are also woven into the discussion of the study's findings.

College Teachers' Planning

Conceptions of college teachers' instructional planning have long been influenced by traditional input-output models. Zhorik (1975) has noted that the traditional "rational, logical, industrial" systems model (objectives, activities, instructional delivery and evaluation) has structured much of the research on instructional planning. Recent research has illuminated and contradicted those models (Clark & Yinger, 1987).

The literature on college instructional planning is both replete with conventional advice and virtually devoid of research, even research addressing the validity of the traditional models. The industrial, objectives-based model hence dominates both the instructional planning literature and teaching improvement guides (e.g. Hall, et al., 1987), even though more recent evidence contradicts this model. Both Zahorik's research and that of others (e.g. Stark, et al., 1988) would suggest that for both K-12 and college instruction the nature and scope of the field -- the content area for the instruction -- is the most salient factor in teachers' planning. In fact, even in interviews that discouraged university teachers from dwelling on content when describing their planning, Andresen, Barrett, Powell, and Wieneke (1985) found numerous instances in which teachers' ideas about the substantive content they were teaching crept into their reports of planning activities.

Research conducted with teachers of younger students also contradicts the simplistic systems model of teacher planning. Clark and Yinger (1987) point out that the traditional four-step sequence commonly prescribed for teaching was not until the early 1970's compared with what experienced teachers were actually doing. This research has revealed teacher planning as a "complex and fluid design process" (p. 84) in which teachers are specialists in "designing practical courses of action in complex situations" (p. 99). Clark and Yinger describe several kinds and

functions of planning, and review important research on the thinking processes teachers reported; these studies reaffirm the saliency of the content to be taught (1987, p. 91) and its precedence over rigid conceptions based in instructional strategies or objectives.

For the present study of teacher's planning, this distinction between earlier conceptions and more recent content-focused conceptions was important. The study was designed to include the possibility that fluid, content-focused conceptions might be manifest in the teachers' thinking and planning.

Content Representation

If the content of the field is the most salient factor in instructional planning, then understanding teachers' constructions of that content would be vital in a study of teachers' planning. Teachers' conceptions of the scope of content for their teaching have been investigated by two groups of researchers, one concentrating on teaching in public school classrooms and one studying higher education.

Through the past decade Doyle and his colleagues have offered new conceptualizations of what constitutes the classroom curriculum by studying teachers' content representation -- the ways in which the curriculum is made concrete in the classrooms tasks teachers define for students (1986). Working with university teachers, Donald (1986, 1987) and her colleagues have investigated the ways the content to be taught is structured in the mind of the teacher -- with particular interest in differing models for content representation among differing academic fields.

While not specifically focused on teachers' content representation, the recent research by Stark and her colleagues also found substantial course planning differences by field, suggesting that the nature of the field does influence the planning to be undertaken. They also found even in introductory courses "that faculty gave much attention to discipline or content, less to contextual issues, and very little to speculating about how students learn best" (Stark, et al., 1988, p. 5). They also found that how faculty characterize their field, e.g. as a mode of inquiry, or as a set of concepts and operations, also significantly influenced their planning.

These research efforts suggested that an investigation of teachers' planning must include attention to ways the teachers conceive of the subject matter to be taught. Content representation would be manifest, the Doyle and Donald studies suggest, both tangibly in the actual tasks assigned to students and more implicitly, as the Stark et al. work suggests as well, in the ways teachers think about their teaching and their intentions for students.

College Teachers' Views of Instruction

Several researchers have recently emphasized the important effect that teachers' beliefs, theories, and views of instruction will have upon their teaching. Stark and her colleagues found, for example, that faculty members "tended to arrange course content in ways that reflected both their view of their academic field and their beliefs about educational purpose" (1988, p. 4).

They found that both the characteristics of the field itself and the teacher's beliefs were extremely difficult to separate from their overall thinking about instructional planning (p. 5).

In their investigation of the most salient topics in teacher planning, Andresen and his colleagues found "theoretical views and beliefs about teaching and learning that underpin the ways in which teaching is organized and conducted" and concluded that further investigations should "provide clues to the implicit theories of education held by teachers" (Andresen, et al., 1985, p. 326).

Over a decade ago, Clark and Yinger (1979) gathered the research evidence on teachers' implicit theories. Whether termed a "personal perspective," an "implicit theory," a "conceptual system," or a "belief system about teaching and learning," a teacher's implicit theories define such things as the elements of teaching "that are most important, the relationships among them, and the order in which they should be considered" (p. 251). Reviewing in great depth the variety of approaches to defining and studying teachers' beliefs, Eisenhart and her colleagues offered a conception of teacher beliefs useful in planning this study; they use "belief" as "a way to describe a relationship between a task, an action, an event, or another person and an attitude of a person toward it" (Eisenhart, Shrum, Harding, & Cuthbert, 1988, p. 53).

From another perspective Fenstermacher (1986) has developed the idea of teachers' "practical arguments" (a term referring to ways teachers' beliefs and classroom actions can be linked) and their role in teacher thinking and action. Although the practical arguments concept was developed originally to aid in relating teaching research to teaching practices, it has provided useful clues in the search for ways to conceive of and study teacher thinking and action. After initially resisting the enthusiastic adoption of his practical arguments concept by researchers studying teacher thinking, Fenstermacher has more recently acknowledged that the notion of teachers' practical arguments can serve as "a kind of analytical device for understanding how teachers think about what they do, for helping teachers gain a sense of the basis for their actions" (1987, p. 416), to help teachers become more reflective about teaching, and perhaps to bring about teaching improvements (Richardson-Koehler & Fenstermacher, 1988).

These and other varied studies' findings clearly suggested that this study of teacher planning should be designed to reveal evidence about teachers' beliefs and views about teaching and the relationship of these to teachers' actions.

The Academic Task

In his work on content representation in the curriculum, Doyle first introduced the concept of "academic task" as an analytical tool for conceptualizing and examining how subject matter is enacted in the classroom (1983, 1986). Addressing higher education in particular, McKeachie and his colleagues (1986) provided a useful overview of the current research and conceptions of what is considered to be the academic task for college learning, pointing out that academic tasks can be conceptualized in various ways and citing Doyle's model as an example that could prove promising for research on college level academic tasks.

In a fields such as architectural design, pediatrics, or journalism, conceptions of "the task" are especially important because learning takes place chiefly through the reciprocity of student

performance with teacher comment on that performance. Central to teaching in these settings is the nature of the assignment itself, including teacher thinking and planning for its design and implementation, together with teacher response to student performance in informal exchanges and formal reviews. In this type of teaching, then, it is essential to highlight the task, the student's performance (which can be conceived as the student's response to the assignment) and the response of the teacher to that performance. This study was designed to give special attention to conceptions of the academic task and students' and teachers' responses to it.

Research on Studio Teaching

While studio teaching has been the subject of extensive discussion for many years, research on studio teaching has only recently been attempted. Studio teaching was a major impetus for Schon's landmark work on the nature of practice (1983) and his inquiries into instruction for professional practice (1987). Studying landscape architects, Bray (1988) used stimulated recall to investigate how instructors think in both large group and studio settings, and to explore teaching improvement; she reported six areas of the instructors' reported thought content and nine of process, with substantial variation among the instructors, mostly attributable to level of teacher expertise. Dinham (1987) discerned eight major themes in studio teaching. Of the eight categories, several concerned the students and the studio milieu, while three particularly addressed matters of teacher thinking and action: teacher philosophies and views manifest in teaching, teachers' ideas about teaching and learning, and the manner in which the teacher responds to students and their studio work. The present study was planned to be especially sensitive to the presence in teachers' planning for their studio instruction of the themes identified by Bray and by Dinham, and to seek evidence concerning Schon's conceptions.

The Study's Paradigmatic Frame and Boundaries

The great majority of studies forming this study's theoretical underpinning rested in what is usually termed a "naturalistic" paradigm: they were conducted in the natural setting, they addressed questions or explored problems of contextual importance, many of the investigators acknowledge that the "reality" they study is multiple and socially constructed, and that change throughout that "reality" is an inevitable aspect of the research process itself, and they recognize that the inquiry itself is value-bound (Lincoln & Guba, 1985). Most of these studies also may be termed "qualitative:" they are empirical and context-sensitive, their (often multiple) methods are inventive for the setting and yield narrative data, their data analysis methods are complex and cyclical, and the findings (also multiple) are interwoven to yield a complex portrayal of the entity under study.

The present study likewise rested in a naturalistic paradigm, raising questions answerable only through exploratory methods employed in a naturalistic setting, through context-responsive research approaches yielding narrative data. The study's conceptual frame drew from the theoretical underpinnings described above. The study was bounded in several ways. It focused on only certain aspects of teaching -- those pertaining to the studio as the setting for "apprentice" study, and within the studio those connected to the problem assignment. Teachers

and their influence upon student work were the principal focus; excluded were other influences in the studio such as the physical setting and extra-studio curriculum. Excluded as not immediately pertinent aspects of teaching were such other teaching activities as the mentoring and advising that fall to all faculty members as part of their teaching responsibilities.

This study was context-bound in many ways, just as all research is context-bound. Probably most important among the study's contexts was the investigators' academic heritage in psychological (as contrasted with, for example, marxian or socio-linguistic) interpretations of the forces and actions important in a teaching/learning environment (this influence is elaborated below). Close on the heels of that contextual limitation is the paradigmatic heritage accompanying psychological training -- because of the experimental domination in psychology, an investigator embarking upon naturalistic research employing qualitative methods is more likely to design a systematic study than at study that is entirely revelatory. Another deliberately contrived context for this research was the choice of the design studio as a surrogate for all "applied" settings in which apprentice learning and teaching occurs; this choice is explained above and the setting described below.

Among the qualitative approaches currently in use, this study's would most likely be termed "systematic," (Smith, 1987). The study began with specific generative questions, posited an at least approachable reality that might be comprehended independently of any particular investigators' constructions of it, identified theoretical streams to guide aspects of the data collection, deliberately employed multiple interacting data sources, used emic data to generate etic findings, and included efforts such as triangulation in verifying patterns and suggesting their meaning.

The Study Plan and its Implementation

Yinger (1987) has addressed the vexing difficulties in studying teacher thinking as it occurs in interactive teaching. Studying teacher planning presents equally vexing methodological problems, although for somewhat different reasons. While stimulated recall is not as necessary a technique for studying teacher planning as it is in studying interactive teaching, in studying planning some method must be employed to reveal the teacher's intentions and thought processes. As with video-stimulated recall, direct questions to teachers about their planning can reveal important information but cannot escape the bias of contrivance. Other less direct methods must be used to reveal a richer picture of the teacher's thinking.

This study employed multiple sources of data. We (1) two investigators (2) followed the teaching throughout an entire semester. This particular course was taught using a team teaching arrangement common to studio teaching, in which two teachers were jointly responsible for this advanced studio. We therefore could collect data on these teachers' thinking not only from (3) directly questioning both of them but also from (4) observing exchanges between them. In addition, (5) the teachers presented the assignment to their class not once or twice but three times early in the semester. Evidence from these three often informal presentations to students also provided information on the teachers' thinking and planning. Altogether the opportunities for triangulation recommended by Yinger (1987) were

designed into this study, although we were mindful also of the cautions about triangulation recently enunciated by Mathisen.

The Investigators and their Perspectives

Because the investigators themselves provide the instrumentation and hence the constructed reality for a study like this (Smith, 1988), a brief overview of their background, responsibilities, and interaction in this study is in order. Goetz and LeCompte (1984, p. 101) quote Wolcott's observation that ethnographer is the "essential research instrument." They go on to point out that ethnographers are "able to go beyond ... recording and to raise finely tuned questions, test out hunches, and move deeper into analysis of issues" (p. 102). Although the present study was not an ethnography, these principles nonetheless influenced the study in important ways. As innumerable recent writers on qualitative research methods have acknowledged, a study like this is inevitably influenced by the investigators' perspectives and experiences, both with the subject being studied and with related cultures, questions, or issues.

Moreover, this study benefitted from many of the advantages of teamwork discussed by Lincoln and Guba (1985, p. 237) The team members brought different theoretical perspectives to the study, the two took on multiple roles with each capitalizing on her strengths, and the two brought to the study complementary backgrounds for data interpretation.

The study was initially conceived by an educational psychologist faculty member with longstanding ties to the school of architecture in which this research took place. She had established herself as a welcome, if not entirely integral, part of the "culture" to be studied. She had consulted nationally with architecture education groups and had presented papers at architecture education conferences. At the study school she held adjunct rank on the school's faculty and had twice taught a graduate seminar on college teaching. A specialist in postsecondary professional education, she had conducted research on medical education in the past and had studied studio instruction in this architecture school and three others over a three-year period. Her research on studio instruction had concentrated on interactive teaching, focusing on student-teacher exchanges in the studio itself and in reviews, or "juries." She was therefore intimately familiar not only with architecture curricula in general but also with the studio setting in particular and the nature of studio assignments, work, instruction, and evaluation. She had recently studied and taught courses in naturalistic/qualitative research techniques following a 20-year career emphasizing traditional research models and statistical analysis. This investigator's role in the present study was to establish the entree for the research, collaborate on the study's design, observe and monitor the data collection, perform the data analysis, and draw and report the study's conclusions.

The second investigator was a specialist in the processes of teaching, teacher thinking, and teacher education. Formerly an English teacher, she had extensive experience with language analysis and the assignment of meaning. A doctoral candidate in education, she had conducted research on primary and secondary school teaching, addressing such topics as teaching expertise, experienced/new/student teacher differences, teachers' conceptualizations of their roles, and teachers' knowledge. She was unfamiliar with the architectural design studio in particular, but because of early education in art had some experience with the studio as an instructional

setting. She had studied qualitative research methods and conducted several qualitative studies of teaching prior to this research, in which her role was to design the data collection plan including drafting the interview questions, conduct the interviews and observations, and make a preliminary review of the resulting data.

These two domains of expertise meshed throughout the study. The junior investigator rapidly became familiar with studio teaching in particular and architectural education in general as the study progressed, and the senior investigator integrated her newly-developing familiarity with research on teaching and teacher thinking with her perspectives on professional education in general and studio teaching in particular.

The reciprocity of the two investigators' perspectives emerged especially during the first round of data analysis, when such exchanges as the following were added to the disks to supplement the narrative data. This exchange between the investigators was inserted at the end of the typescript for the second (and most conceptual) presentation of the assignment to the students. The teachers had been firing ideas and examples at the students to show them the range of opportunities in the assignment and the alternatives for students' choice of their own particular focus. At the end of this segment one teacher asks "any questions?" There is silence and the observer (Investigator 2) comments, using parentheses to indicate that it is her own comment:

2: (No one dares asks questions)

at which point in the typescript Investigator 1 queries 2, who replies, and a dialog ensues:

1: Is this your comment or his? If his, he's pretty much aware of how their free associations overwhelmed students!

2: Yes [it was overwhelming], <u>but</u> (which makes it clear!) ... My discussion with [student] indicated that many began thinking immediately of what they wanted to do and they wanted it to be their own idea.

Problem your note suggests that I hadn't thought of is: The only students still following at the end were (a) totally engaged in this free-association problem solving style and they didn't want help but just wanted to "open more doors;" or (b) hadn't decided what to do and didn't know what to do, so they tuned in for the <u>whole</u> presentation -- now they are <u>really</u> unsure what the assignment is -- their question would be something like "what is it you want me to do?" or "if I choose a vacant lot can I do anything I want on it?"

... Also, this is a neat note from you, because one of [the teachers'] beliefs statements is that you get students <u>not to simply copy your ideas</u> by this kind of telling them all.

1: That is, not copy teachers by [teachers'] telling too much ... lots of detail, but as illustration of principles, not detail for itself -- detail is too sketchy to be copied?

The Teachers and their Project

The study's two teachers separately represent two common levels of studio instruction staffing. One is the teacher graduates invariably name when asked to nominate good teachers; he is a senior, distinguished faculty member with a national reputation in his specialty. The other in this semester's team-teaching assignment had been his co-teacher in other semesters; he is a younger but not inexperienced instructor with a good teaching reputation who teaches half time and maintains a private architectural practice.

The particular project in this fifth-year (of a five-year undergraduate program) course was an urban design assignment on which students worked for ten weeks of the fifteen-week semester, analyzing three major traffic corridors, studying several adjacent square mile areas, and proposing new solutions for the city of over 600,000. Both teachers were personally and professionally intensely interested in the complicated problems of urban reform in growing cities, and therefore brought to the course not only their intentions as teachers but their personal commitment as professionals to the problems the class confronted.

Scope of the Larger Study

The present study was part of a larger investigation of these two teachers' instruction throughout the course of the semester-long assignment. The larger investigation, guided by the first generative question (above), examines not only the teachers' planning and intentions -- reported here -- but also their interactive teaching both in the studio and in final reviews held at the end of the semester. Altogether data for this larger effort were collected from five sources:

*detailed notes from two sessions in which the two instructors brainstormed and negotiated their ideas about this project assignment and how it would be carried out

*extended interviews with each teacher separately on the intentions, planning and implementation of the project assignment

*detailed notes from three class sessions in which the instructors presented the project assignment to students

*interviews with students about the assignment and their work on it

*notes from observations of both teachers as they worked with students both individually and in teams, both in "coaching" the students and in evaluating their performance

The present investigation of teacher planning emphasized the "teachers' thought processes" portion of Clark and Peterson's (1986, p. 257) model of teacher thought and action, and in that emphasis concentrated on teacher planning and theories/beliefs; consequently this study employed the data from the first three of these five sources. The entire Clark/Peterson model, which also incorporates teachers' thinking during instruction, teachers' actions, and their

observable effects, will be addressed when all five data sources are used to examine links between planning and interactive teaching.

Data Sources and Data Reduction

The several direct and indirect sources of information from teachers in this study constitute the study's "sample" of data, as described by Goetz and LeCompte (1984), Lincoln and Guba (1985) and Miles and Huberman (1984). As Miles and Huberman point out, qualitative research is "essentially an investigative process, not unlike detective work" (p. 37), and these data provide the clues in that investigation. These data became available serially, as Lincoln and Guba point out can (and often should) occur (p. 234), and because the sources were serial, each shaped and enriched the subsequent sources' pursuit and usefulness.

Interviews with Teachers

Individual interviews with the two teachers provided the richest source of data for this study. The interviews were conducted early in the project, after the students had each chosen a focus and had been working for perhaps a week. The questions were designed to elicit from the teachers a range of views, from their broadest to their most specific conceptions of teaching. Our most important guide in the construction of the questions was Spradley (1979). The interviews were structured on a broad-narrow-broad plan: the initial questions were "grand tour" questions, the middle of the interview was more focused, and the concluding questions were again global.

Initial questions were deliberately unstructured to allow the teachers to respond in any way they wished, and by so doing to reveal their most salient conceptualizations of the project. The first question was "Think about the assignment your students are currently working on -- and tell me about it." To this question one teacher responded with a listing of the various purposes assignments like these can serve, while the other's response placed the assignment in the context of the way learning from this project could influence their later, professional lives. This question and the others were followed by probes: "can you tell me anything more about that" Several other broad questions followed, for example "How is this project going?"

The transition to the middle portion of the interview evolved through successively narrower questions. The more specific portion of the interview included such questions as "what kinds of assignments are there?" and "what are the parts of an assignment?" To investigate the teachers' thinking throughout these important early phases of the project we asked "what have you added or taken away or changed since you started it?" and probed carefully for rationale and consequences. The question "what is a tough assignment?" was an especially rich source of clarification not only about projects like this but also about the teachers' views of students and learning.

The final portion of the interview moved to more global questions beyond the scope of the particular project assignment. By asking "What is the role of the teacher in a project like this?"

we extracted more about the teachers' view of teaching. The last questions were particularly broad, for example "What is the relationship between this project and teaching architecture generally?"

Teachers' Brainstorming

The more substantial of the teachers' two brainstorming sessions occurred just before the assignment was to be presented to students. The semester had already begun, with students spending about three weeks in teams studying three major traffic corridors through the city; the present problem would begin as soon as those preliminary analyses were completed, and would extend for ten weeks. The problem assignment had been described in the syllabus and alluded to early in the semester but had not yet been presented to the students in any formal way. This spontaneous session was initiated when "both teachers had commented about student confusion over where they were going next, and a sense that things were sort of done or almost done on the [initial] corridor study, and they needed to get students into the next part of the problem" (this quote is from the observer's notes).

This first brainstorming session moved rapidly from the teachers' perceptions of students' confusion to the body of the discussion -- establishing a set of concepts that together could form the basis for structuring students' work on the project. Through this session the teachers interspersed this emphasis with comments on their expectations for student performance and for typical student response. Through the early phases of the discussion the teachers focused almost exclusively on establishing a network of concepts that as a whole would encompass the urban design opportunities presented by these city corridors. In the later phases of the discussion, the network of concepts became less salient in the discussion, and the teachers moved to greater emphasis of instructional logistics.

Following are excerpts from these narrative data, taken directly from the discussion. These excerpts demonstrate both the guiding concepts emerging in rapid succession and also the concern for instructional logistics:

> K suggested a possible problem could be destinations;
> C suggested a shopping center and other magnets. ....
> C then suggested that the intersection should be separate from the destination designation. ...
> C suggested vacant property -- those who choose this would have to do a comparative study with another vacant site
> K continues "I want to say 'districts' and 'edges' -- then he says "maybe we could structure that way" using Kevin Lynch [categories]
> C reviews their list as follows: points, magnets, intersections, loops/lines, mode changes, districts ...
> C then asks "Do we want students to look at corridor proposals? We want a group to look at [doing] a videotape." He questions, "What's a good size for a group?" ... C questions whether the videotape group can finish at the same time as the other groups. He comments further that this group will need to be real organized. ...

> K suggests "We have a tendency to state the problems in an abstract way and they don't know where to go from here." C mentions a particular student and a problem with a particular kind of subtle problem with streets on a past assignment like this. K then says "They don't have a good handle on what they can do. We can be helpful with a specific site with a student over a desk."

The second brainstorm occurred later in the semester. This was a casual discussion about student difficulty and organization; the conversation was discovered and recorded serendipitously when the observer happened to be in the studio and was invited along to hear the teachers' exchange of ideas. Unlike the first brainstorm, for which fairly detailed notes were available, this session's topics and themes were recorded on whatever was available -- in this case two scrawled yellow pages plus a piece of cardboard. Although this session was initially motivated by logistical problems, the teachers dealt with all elements of their project assignment, from its global intentions to the details of student presentations.

Presentations of the Project to Students

The course syllabus, used for marketing the course as well as having been distributed at the start of the semester, first described in great detail the assignment of the three-week introductory analysis of the city's traffic corridors. Immediately following was a description of the 10-week student project that used these phrases: "Individual projects based on selected projects, sites, and opportunities in the [city's] corridor areas. Projects will be based on the desire to increase the intensity of land use within these corridors. Projects will be in new housing, comparative housing studies, infill housing possibilities, commercial densification, park and ride lots, nodal development, linear development, transportation facilities and others."

For the first presentation of the problem assignment to students the more senior teacher began by saying that this was just a quick overview and that students should think about the issues the project might address; a more complete presentation would come at the next class session. The chalkboard bore an outline of the categories posed by Lynch (1960), whose theoretical frame the teachers had chosen for the project. The teachers alternated discussing elements of the outline, suggested various ways individual students' projects could draw from the Lynch concepts, and responded to student questions.

The second project presentation began again with the Lynch categories, was more lengthy, and addressed both the conceptual possibilities for the students' projects and the project's requirements. Again the two teachers alternated, this time with elaborated illustrations of each category drawn from problems in the local community (for example, bike routes joining schools and parks). Later we summarized this session in this way: "They rest this discussion on theory, give examples, leave the possibilities open, imply that success is possible, explain in several ways (words, diagrams), present so many possibilities that students cannot directly copy their ideas, and do this conceptual thinking before (next session's) specifics on the project's details."

The third presentation to students, which began with the semester's remaining schedule on the chalkboard, emphasized the project timetable and focused on the requirements students would meet at each stage in the project. In this session the teachers also described the role of the

guests who would be invited from the community to critique the students' work. The teachers continued to emphasize possibilities and individual decision making, and on occasion overtly refused to be specific when students requested details. Students were more actively involved in this session, clarifying logistics and at some points helping to resolve dilemmas about requirements.

Data Reduction

The observation and interview narratives from the study's several sources were recorded on typescripts and several copies made of each. These typescripts were termed the "raw data" of the study; they constituted the first level of data in what would eventually be many levels of refinement. These raw data were analyzed by the methods outlined by Strauss (1987, p. 23-25).

The first pass through the raw data was a rough "scanning," intended simply to yield the most general of indications about topics observed or under discussion. The list of these general scanning notes (second refinement level) yielded myriad topics, themes, comments, hypotheses, and exclamations. When grouped, however, and sorted for level of specificity/abstraction, these topics became the first attempt at a set of codes (third refinement level) by which the entire data set could be classified. The scanning process generated also a number of memos.

A few examples will illustrate these several data levels. These examples, while taken from differing sets of the data, all pertain to the same general theme, the teachers' balance between "leaving the problem open" and "giving the students some structure"

Level 1, raw data:	[In first presentation to the students, one teacher says] at the end of class today we'll want you to predict where you'll want to work
Level 2, notes:	Teachers hold the project open as long as possible, but then give students a few detailed instructions to reduce student anxiety evident in their questions
Level 3, category:	Opening/closing

The memos (level four) created at this provisional stage included an initial listing of the emergent themes. Examples of these would be (a) opening/closing the assignment, the (b) multiple purposes the project serves, (c) the interaction of and contrast between the studio setting and professional practice, (d) the way teaching itself influences the teacher, and (e) the actual techniques/strategies teachers employ in helping students learn from the assignment. This four-level data refinement process occurred over a four-month period.

After a month's absence from the data, the emerging provisional categories were listed: there were 29. Using these categories, all typescripts from all data sources were analyzed line by line for evidence pertaining to these 29 topics. Through this process a few more category refinements were made, for a total of (level five) 42 categories, and extensive interpretive notes (level six) were added by both investigators. This process extended over a four-month period. Then, using a locally-designed WordPerfect Macro, the passages coded for each of the 42 categories were extracted from their respective texts and 42 new document files were created.

the thinnest of which contained 2 and the thickest 89 passages. These 42 categories are listed in Figure 1, together with information on their sources. The passages provided the substance for development of what were termed "findings" -- that is, groupings of categories -- and for discovery of the patterns among them.

These 42 data categories, arrayed as 27 areas of findings, together with their annotations, were the building blocks used in a series of attempts to construct an explanatory model (level seven) to comprehensively describe studio teachers' planning for and instruction through the studio assignment. The elements of the resulting model were, finally, reviewed and synthesized into three major, overarching themes that link this study to other investigators' findings on teacher planning.

Model Development

The immediately following paragraphs describe how the study's explanatory model developed throughout the data refinement and analysis. Following are the study's findings about the teacher's conceptual frame, the teacher's personal experience of teaching, and the teacher's conception of students, together with data to illustrate their meaning. These lead to findings about teachers' design of a good problem and their actions in helping students through a solution, and the findings' interrelationships and patterns as they contribute to the explanatory model. Next these patterns and their meanings are explored in the light of the original research question and the six theoretical "streams" originally guiding the study; other theoretical work on teaching is also drawn into the discussion as appropriate.

During the data reduction process, from initial scanning to the master set of categories by which all sets of data were coded, successive model-building attempts (in the manner discussed by Strauss [1987, p. 185]) were memoed. Initially it seemed reasonable to distinguish between the "context" for teaching -- what the teacher brings to teaching -- and the "actual" teaching -- what teachers "do." Very quickly, however, this conception's inadequacies became clear. Conceiving of "actual" teaching as what teachers "do" eliminates the centrality of the student, it relies too heavily upon externally observable action, giving insufficient attention to teachers' thinking; it gives insufficient importance to the problem assignment (which in design and other apprentice teaching is central); and worst of all, it reinforces the common conception of teaching as principally instructional delivery.

A second conception that might have been useful as the organizational model for this study's findings was suggested in the final phrases of one teacher interview:

> "I really think that there are two parts to [teaching] studio: one is thinking of a good problem and the other is helping students through a solution."

As it turned out, this conceptualization became a useful organizing scheme for describing studio teaching but could not bear the responsibility of serving as an explanatory model because it does not account for the factors influencing teachers.

Figure 1: Initial Code Categories by Data Source

	Interviews		Brainstorm		Presenting assignments			
	K	C	1	2	1	2	3	L
Coding Categories:								
Teachers' conceptual frame								
Teacher view of the world	13	5				6	1	
Teacher view of what constitutes designing	9	4				1		
Teacher view of the design process	17	11	1					
Teacher's view of the learning process	27	28	2					
What constitutes appropriate design teaching	32	15	1				1	1
The teacher as person								
Teacher rewards	11	8						
Teacher risk	5	2						
These 2 teachers in particular	3	1	3		1			3
Students as seen through teachers								
Student characteristics	22	13	1	1		1		
Success and confidence	6	10				1		
Student risk		1		1				
Ambiguity	1	10	3		1	2		1
Students "display" their thinking	4	2		1				
Student responsibilities		3	1					
Students influence teaching	8	2	1	1			1	2
Students influence the project	2	3			1			
The Problem								
What constitutes a good problem		8						
This studio in/re the curriculum	4	1		1				
This studio cf other studios/the curriculum	6	12		1				
Purposes, goals of [this] problem[s]	17	6				3*		
The theoretical frame used for this assignment		2	2	1	2	5		
Role of prototypes in the problem conceptualization	8	4		1				
Focus on/importance of the product		4	1					
Relevance of the problem to arch. practice	12	5	1				2	3
Visual/graphic aspect of the project	4	4						
Teaching: What teachers "do"								
They think about students' thinking		8	3					
They open/close the assignment	13	15	5	1	6	14	6	1
They design through triangle of their intentions, student characteristics, logistics		1	5					
They deal with constraints	6	5						
They improvise	5	2						
They employ many instructional strategies	39	35	6	2	2	2	3	
Methodological notes	7	9	1	1				2

Progress on model development was next advanced when the notion of the "context" for teaching was more broadly conceived to include various categories of teacher thought including design of the problem assignment itself. Other major elements of this next attempted model were the student and the nature of the person who is the teacher. This model was still inadequate, however, because the notion of "context" had become muddied; one person's "context" could be another's "teaching." It seemed prudent to jettison the notion of "context," but not the elements it might include.

The most satisfactorily explanatory model evolved after the complete set of data had been scanned several times and several provisional coding schemes attempted. It combined the best elements of all previous solutions as well as eventually providing inspiration for a pictorial metaphor for some of the findings. This model is illustrated in Figure 2.

Influences upon Teachers' Thinking and Planning

The Teacher's Conceptual Frame

A teacher's conceptual frame is a set of views brought to teaching, a complex of experiences, beliefs, and expectations. A conceptual frame for teaching design was found in this study to consist of the teacher's "world view" -- in this case a profound social commitment -- combined with the teacher's views of design and the design process, together with the teacher's beliefs about the learning process, which together in interaction constitute the teacher's view of appropriate design teaching.

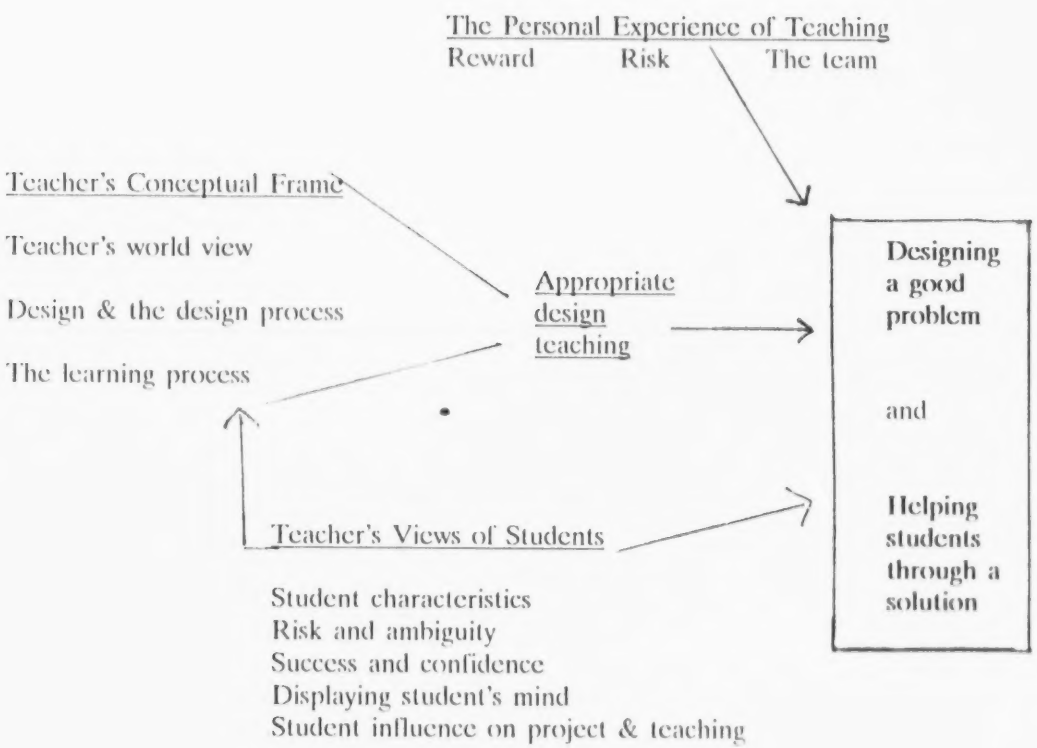
Teacher's world view.-- In this study the broadest of personal philosophies emerged. With these two teachers the underlying theme for this urban design course emerged as a social commitment -- both to the community at large and to the people who live in that community. These views were expressed most clearly in the interviews -- for example:

> the only reason for a whole bunch of people to live together is so that there are more choices, more human choices. The choices ought to remain as equitable as possible; they ought to be fair. ... And the role of government at least is to constantly balance those choices and constantly spread them out so that there are more and more choices of all kinds. Otherwise there is no point in living in a city that is this congested. ... The role of the urban designer is to think of ... creative, significant alternatives that make a difference in the way a person lives or where they live or how they get to work ... not to make the choices [but to offer the alternatives].
>
> I'm on a commission that's trying to do something to make the city better.

Their social commitment includes concern for the lives of the people in the social environment for which they design:

> in other words if you are a little out of the mainstream in American cities you suffer a real humiliation, unnecessarily

Figure 2: Influences upon Teachers' Thinking and Planning in the Design Studio.



and as a result they want students to

> understand that there are people who live in the same city, who have completely different socio-economic level, who [are] human beings just like them...it's wonderful for them to see that in those areas of the city there are some great qualities

> understand a lot more about the issues in the physical design of the city and how some of it could be improved ...[including]...the kind of prejudices and unfairnesses and just stupidities and lack of coordination that are built into a city.

and ultimately they want the students to

> be more active as citizen participants in whatever decisions are being made in their city.

These personal philosophical views and hopes for students' views of the same issues will be woven into the design problem these teachers assign. The teachers explain that in order to address these important issues the assignment should be

> directly applicable to real problems in the community; [it should be] making some sort of ...contribution to the general public

and so in teaching, the teacher must consider how to address these important issues in the studio assignment:

> you've got to make them believe or understand that you think the problem is important and that you think that it's valuable to learn how to solve problems like this. ... It's a lot more realistic if the problem is realistic; if it's obviously a problem. We're trying to do that in studios -- change the way [they] look at the urban environment around them by forcing them to look at all the stuff that they [usually] don't look at.

In order to implement these ideas, the teachers will design their problem assignment carefully, and will direct the students to discover a sense of the community for which they are designing:

> it's really a current question in this community so they read about it in the papers, and they understand that they're working on something that's not pretend but that has some really very real applications ...

> we're asking them to look at the reverse ... the spaces between buildings, the parts of the city that no one's looking at, the views of a city that no one ever gets.

When describing the problem to the students, the teachers ask that the students address such questions as whether their solutions serve real problems; for example

> [will this bike path] really serve a known bicycle designation?

And will it serve real, and important, people problems? For example,

> most at-risk bike riders are kids this age; it seems we say "here, kid, here's your bike, now get to junior high school if you can."
>
> [If you do the bike/pedestrian study] you select a well looked-after group of people, whereas the [mass] transit study involves a larger, less looked-after group of people
>
> [and in developing a city] is price the only choice? ...

Then, when they arrange the logistics of the semester's activities, the teachers bring in members of the community who are currently embroiled in some of these questions. They make the studio itself (or, more precisely, the studio review session) a form of contribution to positive community effort by being a neutral forum in which discussions of conflicting points of view can take place among community people invited as reviewers for the students' work. The teachers comment:

> students will see some of this because we're actually going to try to get some people who will disagree

and when describing the forthcoming review sessions to students, the instructor describes the various groups of invited reviewers, including some who are advocates of change in the local community.

Design.-- Another aspect of the teacher's conceptual frame is the teacher's notion of what constitutes the overarching content of this course -- in this instance design and the process of designing. Again, the majority of these text examples emerged in the interviews, but the themes were also manifest in the way the project was described to students.

Teachers speak of design and designing in terms from the most global to the most specific. Two examples will illustrate the global side of their thinking -- one illustrated in simile and one resting in the theoretical foundation for the design problem. In explaining the design process one teacher illustrated with a simile:

> It's like opening a bunch of doors. It's like being introduced into a building and I say "Okay, Stefinee, this is your design problem." And you're looking at a four-story building. So you start opening doors.

But secondly, in assigning this problem, these teachers represented design to the class as theory-based. They chose a theoretical conceptualization of urban design offered by Lynch (1960) as the set of principles that students were to use in their work on the design assignment. This theoretical base is described below, as it pertains to design of the studio problem.

The Design Process.-- In contrast to these conceptual views of what constitutes design, the teachers also gave several specifics on the design process. For example in pondering what constitutes a "tough" design situation, one teacher explained:

> I think the tough ones are the subtle, kind of sophisticated ones where it takes you a long time to understand that you only ought to do a couple of things; that's all that needs to be done,

while the other teacher summarized his view of a "tough" design problem:

> a very easy problem, because every time there is a new requirement it eliminates a whole group of solutions ... so I guess the more open ended a problem, the more difficult ultimately it is.

The "design process" has been discussed by design theorists aplenty. Just between themselves these two teachers gave a number of explanations of the process of designing. Their overall descriptions of the design process emphasized its complexity, and then often moved immediately to the task ambiguity of getting started. The teachers addressed the nature of the design process -- differing more on this question than on any other in the study -- and the nature of the interaction between rendition and thought.

The teachers' overall view of the design process illustrated its complexity:

> Well, architecture is awfully complicated business. ... it ranges from organizational skills, to drawing skills, to mathematical skills, to artistic ...

> [Students will design well] if they can understand that the sort of problem-solving tools they have and the analytical tools, and the ability to think about a problem and have the confidence in their own intelligence and think that maybe they'll be able to think of something no one has thought of before...

> [designing is] very much like living, as a matter of fact. It's just like planning next week or a day in your life ...

> Yeah, there are parts [to the design process]; you can sort of break it down, but I resist that over-analyzing the process into ... a cookbook thing. If we begin to talk about design then we are trapped in a linear language. We're trapped in a pseudologic where I try to tell you after the fact why I did a certain thing when in fact I don't have any idea why I did it.

In addressing the "stages" of the design process, both teachers emphasized the beginning stages

> At the beginning and the ends of things it's difficult, not just for [students] but for any designer

The same teacher continued later:

> One of the most important things is ... sort of a self-definition of a problem....A good part of coming up with a solution is stating the problem well to start with.

But designing is clearly more than starting. The two teachers in this study differed in their explanations of what constitutes "the design process." One describes a linear conception of the process -- a conception that commonly underlies curriculum planning:

> The process really is first understanding what the requirements are that the design needs to solve ... [then] coming up with a conceptual way of approaching that problem. [Then] is trying to work out the pieces of that solution in more detail. The next stage is just to start reassembling those detail pieces into a coherent whole ... and finally to present that coherent whole to someone else who may or may not understand a great deal about it.

To underscore the generality of this description, the teacher concluded:

> In that regard, I've just described a building as well as a bicycle.

The other teacher, in one of the rare places in which the two disagree, describes a cyclical conception of the design process.

> The best way I can describe the part [of the design process] are--are they're cycles I guess. And what you want to look for is the first cycle....a response to the whole problem....Once you've made that response -- particularly if you hear somebody else's opinion about it and you hear some criticism about it, then I think you are ready to make another response, and you reopen the mind...so you go off and open some more doors and show yourself some more images, and learn some more facts and then you respond again. It's those iterative cycles ... I think it's more helpful and more honest to think of response cycles as the most valid way of thinking of the design cycle.

Both teachers described another aspect of the design process, the interaction between thinking about the problem and attempting physical renditions of it. In this case their views coincided. The role of the "product" in the design process was explained not as an end-product itself but as an intrinsic part of design exploration. In one instance the explanation used typically mystical architectural language:

> You design by drawing and then you draw your design. Those two things work into each other....You use drawing as a means by which to design,

while elsewhere the explanation of reciprocity between conception and rendition was more tangibly described:

> In most problem solving if you can get an accurate representation of the problem, or better yet multiple representations of the problem, and just show it to yourself ... you can literally "see" the problem. That's why most architects live with their drawings ...

> [they] go where the problem is and go where it is represented in models and drawings in order to see the complexity of it

In their reflections on design and the design process, the teachers often assumed a thoughtful, long view:

> Unfortunately our profession doesn't get to make a lot of those [basic design] decisions. They're usually sort of handed to us. We have a building to build on a particular site and we don't have very much to do with a lot of the urban decisions, but I think we should have more to do with that.

> And typically whatever [the students do], if it gets into the right hands, will open a lot of eyes -- gee, this is really possible -- what a great idea.

> I think there's a kind of weakness in our profession, because we're trained to look for the particular, unique kind of qualities in any problem, as a way of making our buildings different ... but I think it's even more interesting to approach problems as if you are trying to learn in the design of this problem some things you can apply to other problems or even all problems.

> I really think that their [the students'] goal and your goal ought to be the same and that's to produce the very best kind of things

Teachers' views of the learning process.-- It would seem obvious that teachers' views of learning would influence their teaching. The matter seems beyond dispute. Why, then, give this factor such attention here? The answer is, of course, that teachers' perspectives on learning must be unfolded as a backdrop for understanding their sense of design teaching and for understanding the instruction that actually occurs.

These teachers' views of the learning process included the effects of teachers' care and concern and of the students' confidence, the importance of dealing with a problem that is sufficiently open to be challenging but specific enough to be workable, the usefulness of seeing the problem visually and spatially represented and then successively refining attempts at solutions, and the importance to students of seeing their studio tasks in a larger educational or professional context.

The more senior teacher revealed his view of teaching's purpose indirectly when he complained about current architectural education journals:

> our journals are not about teaching at all -- our architectural journals. They're about sort of esoteric stuff that we hope will impress our fellow teachers. There is very little in that whole journal about how you help students understand anything

Teacher care and concern for student learning implied in this complaint was mentioned explicitly as an element in student learning in several contexts, for example:

> But it's a fact that ... if you let them know you care, they care more. They'll try to communicate better.

Coupled with the sense of care and concern is the teacher's view that students learn better when they are confident:

> if you can get them to do that, it's a wonderful confidence builder ... you just have to keep reminding them sometimes that they know how to do that

Indeed, "student success and confidence" was an important theme emerging in the teachers' perspectives on students (explained below).

In the studio, students have a unique opportunity for success because they have multiple opportunities to refine early attempts and to learn from the repetition. The teachers explained that student learning is better when students repeat/revisit and can learn from experience:

> Learning ... is very much a matter of learning by not doing it so well but understanding you could do it better and .. [often] you never get the chance in your education...that's why the iterative, repetitive kinds of things can be wonderful ... [there is a] confirmation of "yeah, that was the problem, and I understood."

> I'm using video to teach drawing now. A set of videotapes -- and it's terrific because a student can just repeat and just go over and over it until they understand it. And they'd never raise their hand and a teacher would never repeat it that many times in a class ... but in terms of helping them [the person with a meager background in drawing] they're just terrific.

The teachers' conception of the design process translated also into a firm view that the design learning process is accelerated when students can see their work before them:

> You can go shoot slides and they'll have little piecemeal understandings, but until they're able to look at a piece of the city [i.e. represented in a model] like they were hovering over it in a helicopter and see it all together and see it all interrelated, I don't think they begin to understand ... you have to go where the problem is and you have to go where it is represented in your models and in your drawings in order to be able to see the complexity of it.

These teachers expressed an exquisite sense of the degree of openness, the unfamiliarity and consequently the challenge necessary for optimal learning to take place. This theme became one of the most important in this study, extending throughout the findings in various manifestations. One teacher explained

> you just try to leave it as open as you can afford to leave it without threatening the structure of the whole thing but close it enough so that they can understand it.

And his colleague explained this theme in another way:

> I think anytime educationally you can hold a few things the same but change almost everything else and have students apply their knowledge, their abilities, their intelligence in a completely different situation that they've never had before ...

And yet,

> there's a general tendency that they have which is to shy away from problems that seem to be open-ended and difficult and so they'll kind of latch onto something they know a little bit more about. ... Obviously the most learning occurs when you're asked to do something you know [how] to do. But they ... want to be asked to do what they already know ... they feel more comfortable obviously.

When they were brainstorming the assignment, one of the teachers revealed this sense of balance between too much and too little openness in the assignment when he commented

> We have a tendency to state the problems in an abstract way and they don't know where to go from here.

and a few seconds later, in response to his colleague's suggestion, he said

> they don't have a good handle on what they can do. We can be helpful with a specific site with a student over a desk.

The "open/close" theme reappears below both in the discussion of good instructional problems and in the teachers' explanation of what teachers "do" to maximize students' learning and to tailor problem assignments to individual students.

Lastly, these teachers believe that students learn best when they can see their studio work in some larger perspective that will give it additional meaning. One instructor explains that he and his colleague have

> tried to give some kind of theoretical basis for what they're doing; on the other hand I think we made a great effort to make it very specific and very practical .. forced [them] to deal with theoretical questions in a very practical context.

He explained elsewhere that they believe

> If they don't develop that ability to sort of step back and watch their education -- I don't think they learn as much.

The other instructor illustrates another version of the "larger perspective:"

> If you can get them involved in some kind of deeper way, it's a lot better. If they can see it somehow as part of a larger process and they are proud and really identify with

> the product ... I think they...get more out of the problem and remember it longer, and [it's] a bigger deal for them.

In sum, these teachers described and evidenced a broad range of views about how their students learn. They see their own concern for and attention to students' thinking as an essential ingredient in student confidence and consequently success. They firmly believe that multiple attempts shaped by teachers' guidance and by continuous refocusing will benefit students, particularly if the balance between openness/challenge and closure/detail can be negotiated. They believe, too, that students learn more if they see how their work exists in larger context.

Appropriate Design Teaching -- The overarching construct in the teacher's conceptual frame we have termed: "what constitutes appropriate design teaching." "Appropriate" design teaching is complex; it may require that many, separate, firmly held principles or beliefs be interwoven.

The term "appropriateness" has many facets. It includes teachers' broadest philosophical views -- in this case social commitments -- as well as their sense of design itself and the design process. Overlaid on these is the teachers' sense of how students best learn architectural design. All these aspects of "appropriate" combine to form a belief system that guides their teaching -- both their planning and their interactive teaching. The complexity and the potential for conflicts in "appropriateness" appeared in several ways; for example one teacher explained that the project was meant to provide

> a real, positive contribution to the general public, although we have a hard time communicating that --

which we take to mean that students may have difficulty understanding this larger social goal. Appropriate design teaching is complex and difficult because there might be conflicts between the broad social-commitment goal and the desire to be clear so students will understand the project and learn better from it.

"Appropriate" design teaching as negotiated by these two teachers combines their somewhat differing views of the design process; one describes the process as linear and the other teacher uses a cyclical metaphor.

"Appropriate" design teaching also requires teachers to manage the conflict between the problem's immediacy and the work's long range usefulness:

> I think that it's nice if they're able to transfer, too. It's nice if they take whatever they learn in a college course, and if it's transferable then it's great. If it's not -- if you can't use it outside of that narrow framework and if a teacher teaches it in such a way that it never occurs to a student that they're learning some patterns and some intellectual skills and some ways of making relationships and distinctions -- they can't see how they're using the same stuff.

There is no single "appropriate" design teaching. Even in planning the larger curriculum there are alternatives to consider and compromises to make, because there are

> lots of ways to organize a curriculum -- ours is building up from simpler to more difficult concepts -- there are many other ways -- you could organize it in ten ways and they would all be equally successful -- if you wind up teaching the full matrix it doesn't matter.

Appropriate design teaching, then, balances competing principles and perceptions in a carefully designed strategy that will satisfy all the elements of the teacher's conceptual frame.

The Personal Experience of Teaching

Teaching is at once intellectual and emotional. Particularly in individual, "apprentice," teaching, where the teacher -- the "coach" (Schon, 1987) -- becomes intimately involved in the student's thinking, it is impossible to understand teaching's intellectual complexity without also addressing its most closely-held feelings. In this study, the personal experience of teaching emerged in three forms -- in the teachers' explanations of the rewards of teaching, in their explanation of its risks, and in the unique partnership evidenced by these two teachers. Most of the evidence for these personal themes emerged in the interviews.

Rewards in Teaching.-- Rewards to teachers extend from the most intellectual to the most personal. For teacher two, for example, the inherent complexity makes teaching interesting:

> I think the most interesting thing about the semester is ... it's naive and sophisticated at the same time; it's demanding and laid back at the same time. There are several contradictions in the way the studio is structured, but that for me makes it interesting.

He explained further that not only is the problem itself simultaneously, inherently simple/complex, but the logistical arrangements for this studio are also both simple and complex, and the fifth-year students are themselves contradictory because they are both advanced in the curriculum and new to this kind of project. He explained that this studio is "high powered," "sophisticated," and "demanding" while simultaneously "low key," "naive," and "laid back." This teaching is

> both real challenging and interesting at the same time. [Because there are 34 separate projects underway,] you have to rachet your head one notch over every time you come to a new desk.

Indeed, this particular studio assignment is especially rewarding; they find it interesting to teach prototypically,

> that's one of the most interesting things about education -- approaching problems in a kind of prototypical way

The problem itself interests both teachers; both were eager to explain how that interest influences their teaching. One said, "I'm very interested in the problem ... really excited about what is going on" while the other advised that teachers

> need to teach what you're interested in...to develop problems that you're interested in solving as well as [problems that] will help you teach students how to solve them

In fact, with this personal excitement, one explained, the teacher can avoid "role playing and sort of 'acting' as a teacher" in favor of realizing that

> the most honest way I can communicate my enthusiasm for the problem and the interest my mind sees in the problem ... is to tell them some ideas I have about the problem....just responding to the problem myself.

Teachers personally interested in the problem are "discovering and analyzing" as the project unfolds,

> "expectantly working at the problem just like the students are. I'm in much more of a learning mode for myself here."

A teacher's conception of an interesting problem can be changed through work with students. These exciting new conceptions in turn benefit students:

> I no longer think any of those transit corridors ought to run in a straight line. ... And I didn't understand that before we started this problem. ... So, my personal conception of the Broadway corridor is completely different than it was before we started the problem. ... These sorts of discoveries are really exciting to me. I think they serve as models for the kinds of discoveries students will make.

New conceptions of this problem, jointly discovered by teachers and students, can also benefit the teacher's future teaching:

> I hope that together, there will be a whole bunch of understandings that come out, that they will have contributed to, and I can use next time.

Rewards in the teaching itself include the shared work with the other teacher:

> The little two-person team is a real pleasure. Sometimes it's a pain in the neck with people who haven't developed that rapport -- you spend a lot of time sort of jockeying for position. ... It's just nice when it's this comfortable.

However for all the rewards there are costs. One teacher asserted that the biggest problem is probably teacher boredom. "Not student boredom, but teacher boredom." Later, in a poignant vignette he summarized another cost -- the mental exhaustion this kind of teaching brings:

> I always tell my wife ... when I come home [and she tells me about things that have happened] ... my eyes kind of glaze over -- just like being a tape recorder -- my tape is

> just all wound up. I've listened all afternoon long and I don't have any more listening left.

The Risks of Teaching.-- Just as the rewards of teaching bring costs, teaching brings risks as well. The personal risks are both professional and internal, and some curricular risks cannot be anticipated.

The chief risk in this kind of teaching -- in contrast with more typical instruction in higher education -- is that the product is public. Whether the "coaching" is musical performance, dissertation advising, or design studio instruction, ultimately the product will be public -- most notably to one's colleagues. Teachers "have some investment in this ourselves," because student work "will be known as a product of our studio," pinned up in the hallways, and reviewed in public sessions.

> The trap for teachers is to ... direct the student too closely, and have them do things that we think would be good -- and will have a good result -- that they don't really understand ... Where it would be better to just spend the time developing their understanding, even if we never got any kind of neat looking result.

In this interview the teacher went on to acknowledge the risk to the teacher of student failure in the eyes of the teacher's colleagues, and the balancing of risks against educational benefits:

> it's one of those things -- where the most risks are there also are the most benefits ... in my opinion it's worth the risk; you just have to try to make the right choices educationally.

The risk of public products is not unique to design instruction, of course. A theatre faculty member says

> We're crazy over here. We really are. We're always sticking our necks out. I'm acting every night in a play that just opened. Thank God I got good reviews. I mean, I'm supposed to be teaching that stuff to students. We stick our necks out to each other too (Noonan, 1989).

A second personal risk arises when teachers must move from "coaching" to "evaluating" students:

> Part of what we're evaluating is our interaction with the student, and we know that was uneven, that some students we were able to help a lot more than [others] ... you're really grading yourself a little bit too.

And in the end, even teachers with outstanding reputations, teachers in great demand, whose every idea is stimulating and every critique enlarging, will be conservative in assessing their own teaching:

> at the end of the day if you did a real good job on half of the conversations you had with students you probably did okay.

Teaching is risky not only personally but for the larger studio curriculum. For example, if project assignments are left to student choice, some important aspects of the problem will go unselected. And for student's selected problems, teachers may be excited and hopeful but

> some of them we don't have many ideas about. We may recognize that they're a problem, but we honestly don't have any solutions -- now there we're going to be learning with the student.

The other teacher echoes this risk:

> they really don't know where it's headed or in some cases neither do we...it might in fact be a fiasco or it might be really successful, and there is no way to know at this point which it will be.

There is, in the end, after extensive planning and careful teaching, the possibility that the teacher might not be able to control the studio's products, that either circumstances or students might change the best-laid plans, that teacher judgments might not always be "right:"

> you just have to listen to what they say; if what they're saying is smarter than what you can come up with, then you'd better be flexible enough to change.

These Two Teachers as a Team.-- The personal rewards and risks of teaching arise in a context -- in this case the context of the particular project and the particular teaching team. These two teachers, like any team of two teachers, is unique.

The teachers not only talked about but displayed their colleague-ship. One for example, explained how, early in the project, they agreed to leave the problem as unspecified as possible for students:

> [we've] worked together for awhile and we find if you make too much fixed early on you can't make any positive use of the information you get all along

and meanwhile the other said

> you constantly have a flexible situation with a student and we try ... and agree quite a bit on this, we'll try to scale back the problem ... and [we] talk about those problems quite a bit. About the particular student and the particular problem.

In the brainstorm, too, their condensed and overlapping conversation showed that their close communication is based on similar social commitment, views of design, and beliefs about students' learning. Occasionally, though, they did mis-communicate in their haste to lay out the theoretical frame for teaching through this problem; the one miscommunication we noted did not, however, seem to have serious consequences.

These two teachers, having worked together for some time, were able to be flexible not only in their dealings with students but also in their planning for this project. They consciously deferred details that both knew would be discussed when the time was right:

> we expect [the problem's next stages] to be ill-defined, and in fact maybe we haven't gotten to this, but [it's] one of the things we're going to be talking about

and they tacitly agreed on the ways they would divide the explanations to students:

> We talk about different things ... sometimes we actually switch over
>
> [interviewer: I saw you do that; it was sort of like it was choreographed. No one said anything; you were talking along and all of a sudden he took over. You didn't even look at him or anything...
>
> Yeah, that happens a lot

This choreography indeed happened "a lot" especially in the third presentation of the assignment to the students, when the students had spent some time thinking about the concepts underlying the project and now needed further guidance. At one point one teacher's explanation of the project requirements was interrupted by the other teacher, who explained that these requirements are typical of the requirements of professional practice; later, in discussion about the models students are to build, he inserted the observation that "there's nothing that will get you into the scale like building models," and went on to describe another class "where the model was built late in the project and the ideas emerged late as well."

These two collaborated in full view of the students, consciously illustrating the kind of collaboration typical of an architectural firm addressing a complex design problem. At one point in the third assignment presentation session the observer commented

> "what happened here that is interesting is that [the teachers] began to puzzle over how to do this, and the students immediately took over and began telling them how to do the base map and what they would do; it was a giant problem solving session at a very concrete level..."

And near the end of this session when details were not entirely clear, the two teachers told the students "we'll get our heads together ... and make a proposition to you."

Clearly any two-person team teaches unlike any other team. Yet the principles of team teaching demonstrated by these two -- their common views of design, beliefs about student learning, and a comfortable sense of partner-like exchange -- illustrate the importance of their colleague-ship in their thinking and their planning for this studio project.

The Teacher's Conception of the Student

All teachers bring to their teaching their conceptions of their students. Indeed, the depth and refinement of a teacher's student understanding is one mark of teaching wisdom. This study's teachers showed a rich understanding of student characteristics and the ways students could be expected to respond to the problem assignment -- including the problems of risk and ambiguity in the assignment. Their intentions for students to learn in a context of success and confidence, and particularly in the end to be able to articulate and display the workings of their own minds, were foremost. The teachers understood and planned for the influence students themselves would have on the evolving project, and on the teaching itself.

Student Characteristics.-- Teachers' views of student characteristics can include their (1) perception of the background students bring to the present learning, (2) understanding of how students' learning therefore rests in part on that background, (3) view that in part teaching includes diagnosing student characteristics, and (4) consequent goals for students' learning.

These teachers saw their students' demographic characteristics as important to the educational process. The students are mostly white, middle-class, and male (although more and more women are choosing architecture majors, they pointed out), often privileged, the younger ones limited in life experiences and social vision, and sometimes spoiled. The teachers believed

> it's really good for them to understand that there are people like that who live in the same city, who have completely different socio-economic level, who have ... families, they have needs, they have wants ... and it's wonderful for them to see that in those areas of the city there are some great qualities.... a lot of them have gone back and had dinner, discovered interesting places to eat, and they talk to people...

Not only socially but in other ways students bring their inevitably limited life experiences to their education. Both teachers mentioned that one goal of this project was perceptual change:

> the first thing is to change the perception of the urban environment, and get them to see it in a way they haven't seen it before

> We're trying to teach them the complement of a lot of the things they've learned in other studios. ... to think about all the things the opposite of what they've been thinking about. My goal would be to have the students have a perceptual change ... [to] think about things in new ways

and they hoped that when students finish this project

> it will ruin their lives because they'll walk around the city seeing things they've not seen before and getting mad about them all the time. You know -- "why is this so stupid" and "why can't something much better be done with this?"

Students also bring to this studio their own ways of approaching problems. Some are

> students who just keep opening doors....they're what somebody calls divergent thinkers [and the teacher must] really work with them to get them to close the problem, to finish and actually do something

while others

> just open the front door and say "oh I know what this is" ... and [with] those you have to give them techniques to reopen their mind.

These teachers were concerned that students suffer from a short-range view of their education:

> It never occurs to a student that they're learning some patterns and some intellectual skills and some ways of making relationships and distinctions ... They can't see how they're using the same stuff....[so a teacher should] get across that what they're learning can be taken somewhere else. That's one of the things they don't understand about their education. They have come to believe that once they finish with something that's it. ... that's one of the real strange things [about students] -- how they've come to believe that.

At the same time, however, these teachers know that students have also gained significantly from their past studio experience. For instance they have developed the ability to formulate, execute, and communicate their design ideas (although more likely in a smaller scale, and more proficiently in two dimensions), and they bring a sense of competence, experience with assembling a project, good judgment, and useful information.

These teachers find students less experienced at displaying their own thinking. Although

> people seem to come to us bright enough ... yet they have a hard time making an argument -- a logical argument -- for a set of ideas

in comparison with their experience at presenting the results of their work graphically. (Occasionally in studio reviews at this school as at others, students are prohibited from explaining their ideas verbally but instead must demonstrate all their thinking through the product they submit.)

Knowing these things about students in general, then, means that they are diagnosticians when they deal with students individually. The teacher-as-diagnostician theme emerged in many explanations of how teachers think about student characteristics:

> The toughest problem for the individual student is where they're coming up short on four or five of the abilities that it is going to take to design the problem, and they just don't happen to have the background
>
> I don't know that they've ever done this before ... they'll be working in an unfamiliar medium
>
> We'll suggest everything we can that's helpful in terms of being within that student's abilities or understanding at the moment
>
> Many times we assess wrongly where the student is or how much they understand but you're constantly trying to get a handle on that--how much they understand
>
> [When students fail] you have to find out if it was a matter of understanding or just lack of effort ... yeah, that's a problem and it varies with every single student
>
> There's a range of students in each section ... and so you need to deal with the range of skills they have.

The refined knowledge of students' background and sense of the teacher's role as diagnostician, color not only teachers' planning but also their long-range goals for students' learning:

> [This is] tough for them because we're asking them to look at stuff they've never looked at before ... we've kind of slipped them a mickey by giving them a problem in skills that they don't have right now. Obviously the most learning occurs when you're asked to do something you don't know [how] to do. ... They need to stretch their brains.
>
> They should be a little self-aware about whether they're good at certain parts of it, and they ought to be consciously working on the parts that they know they are not very good at.
>
> [We want them to] develop that ability to sort of step back and watch their education [Interviewer: and different students have differing abilities to infer that?] Yes, and some of them don't want to know that.

Risk and Ambiguity.-- These teachers understood that their students' task was ambiguous. In comparison with other studio experiences,

> the biggest difference is that nobody has said "we're going to do" anything [in particular] ... it's not a building program like they're used to getting....Here it's much more open ended; it's much more open ended. We're not doing any tight problem definition.

Indeed, these teachers equate difficulty with an assignment's ambiguity, usually expressed in terms of unfamiliarity. They planned this assignment to present three new areas of ambiguity:

> it's difficult because we're asking them to work in an area where they haven't really done work,
>
> we're asking them to both formulate the problem and solve it, and they haven't had a whole lot of experience in doing that, [and]
>
> we're asking them to do ... problems that no one's done before, so there aren't a lot of models that they have to look at.

Further, the problem is so ambiguous that

> they really don't know where it's headed, or in some cases neither do we.

Faced with ambiguity, students invariably try to reduce it by one means or another. One way to reduce ambiguity is to

- shy away from problems that seem to be open-ended and difficult, so they'll kind of latch onto something they know a little more about,

while another is pressing for greater detail, as the teachers saw when they presented the assignment to the students:

> [Observer's notes] student then asks "so this is going to be a design?" and one teacher says "they are all designs." There follow further detailed questions from a student about exactly what they want. Teacher hold this off by saying "Lets get the overview; we can talk details later."

and as the teachers acknowledged when they met to brainstorm their next steps:

> Their questions indicate they don't know what they are supposed to do next....they want a statement of the problem.

Teaching within the delicate area of task ambiguity requires a careful balance between the novelty required for students to learn new conceptions and the specificity needed for success. What do teachers do to maximize the educational benefits of the ambiguity without destroying students' ability to be successful? First, they anticipate the difficulties students will encounter,

> which as a teacher you can see and often they can't. They don't quite know where this thing is headed. They've never done it before so they don't have that experience to rely on.

Then, as a result of their teaching experience they might alter the task. These teachers

> taught this course two years ago and asked students to study streets for the semester. And that wasn't enough of a problem for them. They just had a terribly difficult time ... Now we've tried to make it more site-specific and give them more specific requirements, which I think they'll do a lot better on.

In this case the teachers provided exactly what students want in ambiguous situations -- greater specificity and a clearer focus.

Teachers also must be watchful when students veer into territory that is potentially dangerous because of its special complexities. In this example, several students tried to constrain the ambiguity by focusing in an interesting area of the city, not realizing the extra problems of urban design in that area:

> Two or three students, for example, wanted to do work in historic districts ... I'm trying to steer them away from that, but they're all tending to fall into that area.

Teaching for Success and Confidence.-- Among these teachers' strongest beliefs was their sense that students should be successful in the studio, and should emerge with confidence about their abilities and accomplishments:

> the goal in any design problem for both the teacher and the student is that everybody in the class succeeds over a certain threshold

> we know that all of our students aren't the best designers in the world but they're going to graduate probably and so they ought to have the best kind of success experiences.

In describing the way an architecture studio curriculum is designed, one of the teachers spoke for both when he included success in his explanation:

> You try to start with problems that have less information in them. You try to get them to succeed. You want to pick a problem that they can have success on and so you want to limit the number of variables....

In planning for this particular assignment, the brainstorming teachers acknowledged that students' successes need to be planned for:

> They don't have a good handle on what they can do. We can be helpful with a specific site with a student over a desk.

Individually, also, each teacher affirmed the intent to plan for students' successes. One stated this intention several ways:

> You want everyone to succeed. You don't want them to do something that is so hard they can't possibly succeed, nor do you want someone to do something so easy that they can't possibly fail. You want to push people at all the different levels.
>
> And so you need to deal with the range of skills they have. You can't aim it at the top or the bottom; you have to aim it in between, but you want it so the ones at the bottom can have some success, and the ones at the top can still be challenged.
>
> Well what one does is set a real high standard....They can produce a great deal of work in a very short period of time, and it's kind of interesting to demonstrate that to them....and if you do that I think students tend to be very good at rising to those expectations.

Although in less able teachers high expectations could be clumsily imposed, with these two -- in combination with other strategies and with the goal of success -- it could bring out the best in the students.

The second teacher echoed the belief in student success:

> You constantly have a flexible situation with a student, and we try ... to constantly redefine the problem, based on the students' understanding and their ability to come to some successful completion.

This teacher is especially committed to building students' confidence:

> I think anytime educationally you can hold a few things the same but change almost everything else, and have students apply their knowledge ... in a completely different situation that they've never had before, that is a tremendous confidence builder.
>
> And we say "look what tools you can bring from what you've been learning to this new situation....Remember that you can operate in a new situation very effectively.
>
> You have to keep reminding them sometimes that they know how to do that. You have to show them how this is just like this other thing.
>
> [In describing the teacher's role as studio critic] You leave them with ... three or four suggestions of how they can respond to the criticism ... leave them if you can with some enthusiasm ... so that they are left at the end of the session with optimistic hopes for improving this, so that they know what to do; they know that you think some of their ideas are good.

Teachers inspire confidence indirectly as well, for example by showing students how their ideas influence the teachers' thinking:

> You need to respect their opinion. You know, like at that meeting the other day [presenting the assignment to the students] you just have to listen to what they say. If what they're saying is smarter than what you can come up with, then you'd better be flexible enough to change.

Displaying One's Mind.-- One of the most important skills teachers want students to be successful at and confident in is what one teacher called "displaying your own mind." As one teacher explained, one of the project's goals was for students to "think about presenting their ideas" in new ways with newly refined skills.

Presentation of professional work is an important--indeed essential--aspect of skilful professional practice in architecture, as in many fields. From their earliest studio experiences students learn techniques for visual presentation of their work, and in review sessions learn to present their work orally. In this studio, however, the teachers intended for students to learn how to present not only their work but their thinking as well, and to communicate both to a lay audience concerned with urban issues. Both teachers emphasized the importance of presentation in the semester's project.

Presentation is both a goal for the project and an educational technique. As an educational technique emphasizing presentation can be a way to get students started on a project:

> The best way to get it going is to set a deadline and say "on that day you're going to have to stand up in front of a bunch of people and show them certain drawings and tell them what your ideas are ....

Presenting one's thinking is beneficial not only as a way to get started but also as a way to learn:

> if you have to explain a problem to someone else then it's a real good way of explaining it to yourself, which is really what they need to do in this first phase.

The teachers planned several presentations into the semester's schedule because they believe students learn best from multiple opportunities to practice new approaches and correct earlier failings. In contrast with earlier courses, in this studio the students were expected to explain their thinking in a persuasive way to an audience they would hope to convince. This new approach requires multiple practices because of the change from earlier studio requirement. In their brainstorming, the teachers agreed that students often prefer to describe their design rather than explaining it analytically or persuasively because a description, being noncontroversial, is harder to criticize and therefore less risky.

As a major purpose for the semester's studio project, presentation of one's thinking is an important opportunity for students:

> Something in their life has led them to believe that they're creative and they have neat ideas or the potential to think of interesting ideas. And so the opportunity to present those ideas -- It's like being able to display your mind on that day. You're asked to tell what your thoughts are about this. That's a nice opportunity.

The purpose is more than an opportunity, however; it is a simulation of some important aspects of professional practice.

> So what we're asking them to do is to present to a bunch of people what they think the problem is. ... They're going to have to take these people from knowing nothing about the problem to at the end of twenty minutes understanding the problem, being persuaded that this student understands enough about the problem and has a kind of a handle on how they're going to solve it. And that's terrific experience for architects because you have to develop that kind of confidence in your clients -- that you understand what they want, that you've listened or understood the problem and then done the necessary analysis.

Students' Influence on the Project and on Teaching.-- Particularly in "apprentice" teaching, with the ebb and flow of teacher-student contact, teachers recognize (and plan for the fact) that the students themselves will, through one means or another, shape both the project and the instruction itself. Students exert this influence most obviously in the various ways they respond to the project assignment. With a project assignment as unstructured as this one, there are not 34 students working on one project but 34 different projects underway. In the way they choose a focus and then conceptualize the issues they will address, students control the project they will undertake, and thereby the project through which their learning will evolve:

> We've given them an overall scenario -- we've given them a goal, but it's their responsibility within that goal and within that hypothetical situation to select a problem to solve.

Sometimes students respond unpredictably:

> We had two or three ideas we thought were kind of neat and nobody chose them. They didn't really appeal to any of the students.....And one year we gave this similar thing, and we couldn't get hardly anyone interested in the videotape; this year we have plenty of people very enthusiastic about doing a videotape.

Students also influence teaching when they cannot, or will not, respond to the project assignment. In some cases cultural barriers prevent the student from comprehending the project's nuances; another student may "either totally disagree or have a completely other point of view and kind of fight the problem," or "just dig in their heels and fight the problem;" while in some cases the student "honestly will never understand the problem;" or perhaps students "don't accept the problem as being valid, or they're not interested in it;" and many times "you

find out later it was because they had three tests and two term papers due that some two weeks and it had nothing to do with the problem at all."
While teachers sometimes have no way to influence some of these responses to the problem, when students simply "can't cope" with the project assignment, the teacher can redefine the project for them, sometimes scaling down the assignment or being more direct about the student's choice of focus:

> The toughest problems for the individual student is where [they're] coming up short on four or five of the abilities that it is going to take to design the problem, and they just don't happen to have the background.

> You know, when he said that to me I understood that he had no idea what we were talking about, so I steered him to a vacant parcel project. If he has no idea what we're doing he's most likely to understand that kind of a project. So you want to steer them into things that they can handle.

> You constantly have a flexible situation with a student, and we try ... to scale back the problem. Or constantly redefine the problem, based on the student's understanding and their ability to come to some successful completion.

> [Observer comment during teachers' brainstorm]: Part of what teachers do is to re-conceptualize the task for students when the situation is ambiguous for them.

Students also influence each others' learning. Teachers plan for -- and count on -- the student teamwork in the studio, whether by assignment or naturally as a consequence of the studio "spirit." Additionally, when these teachers presented the assignment to the students, they opened the discussion for some joint problem solving because

> There are students with a lot of experience ... You need to sort of respect their judgment and the information that they have. ... You know, like that meeting the other day, you just have to listen to what they say.

In the presentations to students, in several instances teachers were pondering aloud how best to accomplish a desired end, and students chimed in to suggest how to do it. In one instance, for example, the teachers wanted to coordinate building a complete model:

> Teacher: my feeling is that each person should do their own square mile; it's more efficient if the base model is built by a team

> Student: why not two dimensional where we aren't working, and build up three-dimensional where we're working?

> Teacher: then [it'll be] immediately apparent where the projects are

And the observer commented later

> [The teachers] began to puzzle over how to do this, and the students immediately took over and begin telling them how to do the base map and what they would do. So it was a giant problem solving session at a very concrete level with various students volunteering to do various work and proposing solutions, and with others simply letting the group decide and then tell them how to do it.

And finally, students indirectly influence teaching by their own insights throughout the project's evolution -- a reward the teachers mentioned when discussing the benefits of teaching. One teacher described his insight as the project progressed:

> One really dramatic thing that has changed my mind right away: I no longer think any of those transit corridors ought to run in a straight line ... And I didn't understand that before we started this problem. ... So, my personal conception of the Broadway corridor is completely different than it was before we started the problem. ... I'll try to persuade the students of that, and some of them will buy it and [for] some of them it just won't make any difference. But these sorts of discoveries are really exciting to me. I think they serve as models for the kind of discoveries students will make.

In sum, the students influence the teaching, and especially the project itself, in several ways -- in the way they respond to the assignment, in the choices they make in focusing the task through which they will learn, in influencing the learning environment for the entire class, and in the project's effects upon the teachers' thinking. Expecting and planning for these influences is part of the teaching process -- along with other views of students and expectations about their learning, their conceptual frame, and their personal experience of teaching itself.

The Two Components of Studio Teaching

> I really think there are two parts to studio [teaching]. One is thinking of a good problem and second is helping students through a solution. That's right -- there really are two parts, and those are the two jobs we have as teachers -- to think [about] those two pieces.

This report turns next to these two "jobs" -- designing a good problem and helping students through a solution. While the three important precursors to teaching -- teachers' own conceptual frames, the personal aspects of their lives as teachers, and their views of students -- form the foundation for teaching, we know they do not constitute teaching. For the essence of studio teaching we turn next to the two tasks of problem design and student instruction.

Designing a Good Problem

A good problem, according to these teachers, serves multiple goals and purposes, rests in a theoretical frame that can be generalized to other design problems, and builds on and meshes with the existing curriculum while providing students new opportunities to advance their learning. A good problem is designed to be prototypic, to employ the studio product as a mechanism through which students will learn the design process, to teach important aspects of professional practice, and to use presentation methods not only as a way of communicating results but more importantly as a way for students to think through the design process itself.

Multiple Goals.-- One teacher spoke for both in explaining that "the current design problem has several purposes; it has a whole bunch of different purposes" which they articulated throughout their conversations with the interviewer. In order to accomplish these, the teachers purposefully planned the problem to include certain requirements of students.

The first goal was that the project would

> have the potential of making a real, positive contribution to the general public [because it is] directly applicable to real problems in the community.

This goal is not surprising in the light of both teachers' commitment to urban planning as a way for better cities, better social environments, to be constructed. Related to this goal, as one teacher explained, is another:

> the first thing is to change the students' perception ... to get them to see it in a way they haven't seen it before

and as part of accomplishing this, they were

> trying to build up their vocabulary ... the sort of range of answers ... in the conversations with the students, the students find whole new ways of solving problems or looking at problems ... [he continues later] if education does anything it sort of rattles your cage and changes your perception about a whole lot of things

The other teacher independently had said

> Well, my goal would be to have the students to have a perceptual change ... when you get through with this studio it will ruin their lives because they'll walk around the city seeing things they've not seen before and getting mad about them all the time. I think to some extent we're trying to do that in studios -- change the way you look at the urban environment around them by forcing them to look at all the stuff that ... a lot of people don't look at.

But they not only wanted to change student perceptions; they

> hope[ed] to convince them that there is something they can do about it, both as a professional -- if they're fortunate to get a commission to do that -- and as an interested citizen in whatever city they move do.

In significant contrast with these very abstract goals of social influence and students' perceptual change were several statements of the ways the teachers expected to bring about these changes:

> One of the other purposes is to let them practice developing a rationale to go along with whatever they propose as solutions to these urban problems. And we find that's sometimes very difficult. People seem to come to us bright enough and have been through all the education and yet they have a hard time making a logical argument for a set of ideas

and later he summarized a general attitude pervading their teaching:

> we hope that the whole experience is confidence building,

adding almost as a postscript: "I always hope that some of them will like this well enough to go on into a graduate degree."

The other teacher explained their strategies differently:

> I think the third thing is to ... think about presenting their ideas in a way that a lay audience can understand and respond to. ... We're interested in explaining to people an alternative way of experiencing the city that has to be done in a medium that viewers can understand really easily.

Another mechanism for bringing about the perceptual change was that students would be "working in an unfamiliar medium," as one teacher put it. The "scale is a little different than they're used to," explained the other, who continued "it is at the same very similar to stuff they've done, and also very different."

These abstract goals, more specific purposes, and strategies for achieving them are not separate but interwoven. The social commitment to urban improvement is woven into the understanding that students need substantial perceptual changes. Students' presentations to lay audiences were be one vehicle through which they themselves would assume these perceptual changes, as well as being a mechanism for learning to present a logical argument persuasively.

A theoretical base.-- In addition to having multiple goals, a good design project rests in important design principles, according to these teachers. For this studio project they chose as the theoretical framework a set of conceptions explicated by Lynch (1960). This theoretical framework guided the teachers' and students' thinking throughout the semester -- and particularly in the all-important early days of the project.

The framework first appeared in the two teachers' brainstorming session, in which they generated themes they would discuss as they presented the assignment. In the brainstorm, the two discussed categories such as

> points, magnets (destinations), intersections, loops/lines, mode changes, districts

as general features of the urban environment. Students were told how the theoretical framework would be useful in the future in approaching all urban design problems. In first presenting the assignment to students, they gave each student a photocopy of the Lynch chapter, and later (after explaining that one goal of the assignment was to develop alternative ways of looking at a site) discussed elements of one traffic corridor in terms of "nodes," "landmarks," and "magnets."

In the second presentation the theoretical framework unfolded further. More extended examples were given for several categories, as indicated in the observer's notes on the teachers' remarks:

> I'll talk about radials [says one teacher] -- the radial should have something to do with magnets. But for this assignment, concentrate on the path, not the magnet. An example we have [from a previous semester] is a junior high school bike path: the radial study looked at junior highs, and the key was bike riding.
>
> Now let's talk about a different kind of radial, a neighborhood shopping center. Currently, the quadrant they serve can't get in from the neighborhoods behind. And there is also the problem of street crossing: [a shopping center may be] just across the intersection [and yet be almost impossible to get to]. As part of this radial, think about the needs of the neighborhood it serves. Take apart [the buildings] and color code them. Analyze what you might be willing to add to, and what's missing if you live there.
>
> Now, magnets. Most magnets are places where you go to work, go to school. ... Accessibility? Make the pedestrian environment pleasant. Ask, what can I do to make it more pleasant?

One teacher explained:

> We're interested in looking at theoretical questions but in a practical context ... that might apply to a whole range of situations in [this city] or somewhere else. We've described those generic categories of paths and edges and districts and landmarks and nodes, and tried to give some kind of theoretical basis for what they're doing. On the other hand I think we made a great effort to make it very, very specific and very practical ... they are forced to deal with theoretical questions in a very practical context

And when explaining how students are expected to learn from this prototypic assignment:

> we can put a structure over the whole thing, and [students will] carry that structure around with them and look at other circumstances and be able to place what they're

> looking at in a similar kind of structure [and thereby] understand the relationships about those pieces.

The larger curriculum.-- A good design problem meshes with the larger school curriculum. This studio assignment both fit at a particular point into the school's larger curriculum and was distinct from assignments used in earlier semesters.

The teachers explained that building on prior work helps ensure students' confidence that they can be successful with new, more complex projects:

> By this year and maybe in the earlier semester in fourth year, we begin to change the problem. And we say, "now wait a minute, it's not always going to be the same, but look what tools you can bring from what you've been learning to this new situation. ... A whole bunch of things might have changed but remember what is the same."
>
> We hope that the whole experience is confidence building in that we change a whole bunch of things on them, but they realize that they can make that transfer, that shift, that translation from the problems they've been used to, to this larger, more complicated, more generalized problem.

And in their second, more informal brainstorming session the two teachers mentioned that by the fifth year the students are "good about going along further" because they are good at building from their prior experience.

Yet this complex fifth year project was substantially different from the students' past experiences.

> The biggest difference is that nobody said "we're going to do" anything in any of these situations....Here it's much more open ended. We're not doing any tight problem definition.

The other instructor explained

> They don't have a single design problem ... typically in architecture you give them a very specific problem with a lot of very clear parameters ... we're not doing that. We're giving them a general topic and asking them to both define the problem and come up with the solution.

And when asked about "problem-setting" explained

> In other studios we do [that] a lot for them. We set out -- sometimes in great detail -- what the problem is, and they simply take it and go and find the solution. Here we're asking them to state the problem and then come up with the solution.

The differences between this project and students' earlier experiences extended beyond problem definition into its execution as well:

> We couldn't teach this studio really until fifth year, when they start being comfortable with responsibility for assembling the project and budgeting their time for working with stuff all around .. it's not to say that all fifth year students are very good at that, but the best ones will do very well at it.

Later the instructor summarized: "It is at the same time very similar to stuff they've done and also very different."

For the teachers as well, this project was very different from others earlier in the curriculum. One difference was in the contribution students' thinking in this project can make to the teachers' own thinking, as one previously mentioned:

> Unlike teaching in the lower years, I am sort of discovering and analyzing ... I am expectantly working at the problem just like the students are.
>
> There will be a whole bunch of understandings that come out that they will have contributed to, and I can use next time.

The other explained the difference for him between this project and the earlier work this semester:

> We're going to move to a very different mode. It's going to be a lot of one to one contact ... you're not walking to 16 different desks, seeing minor variations on exactly the same scheme [as in earlier years of the curriculum]; [instead] you have to kind of ratchet your head one notch over every time you come to a new desk and try to remember ...

How a given semester differs from the curriculum at large depends, of course, upon how the curriculum is conceived. These teachers described different conceptions of the curriculum at differing points in the project. One explained the traditional view of architectural curricula and then proposed another scheme that would require a more integrated, school-wide agreement about teaching:

> I started to say most people who have to describe what goes on in this college find it easy to say, "well, we start with small simple problems and we end up in fifth year with big complicated problems." I think that sounds nice, right? But I think the way it's more useful to think of architectural problems is based on the design process -- on the cycle [of analysis, thinking-through-graphics, re-analysis, penultimate products, etc].

He continued,

> Unfortunately we try to do it all with every design problem and we don't do a very good job with any piece of it. ... I think it would be better if the whole curriculum focused on being very clear about which part of the design process we're trying to help the student master -- whether its the conceptual part, the middle part, the very end where we're

> simply trying to ... explain it to somebody. I think that's a better way of categorizing design problems than what is normally used, which is either building type or function type or size or something like that.

This conception of the ideally design curriculum is shared by his co-teacher, who explained his vision using different language:

> There are lots of ways to organize a curriculum. This curriculum is organized one way; there are very different ways to organize it that would ultimately be as successful. We're sort of on a building process [structure] where there are a ... bunch of concepts -- some more difficult than others -- so you introduce the easy concepts first and build up to the more difficult concepts. ... I suspect you can organize it in ten different ways and they would all be equally successful. If you wound up teaching the full matrix it doesn't matter if you end up organizing it by the vertical axis or the horizontal axis you're ultimately going to get a everything on that matrix anyway.
>
> Well, architecture is awfully complicated business. There are a great number of skills that you need and they are all very different. ... You try to structure problems in such a way that the particular problem you're asking them to do emphasizes one of those skills over another and that by doing a whole series of different problems and emphasizing different skills each time -- and then finally they use all the skills.

The particular studio's place in the curriculum was described by one teacher waxing philosophic about architectural education:

> We have the burden in the design studio ... that this is the place where you apply all the knowledge from all the other courses. And we get criticized -- or we're self critical sometimes -- because we really don't do that very well and I'm not sure that we can. We try to get the students to think about other courses and what they have learned from those other courses. One of our problems ... is that we've all taught together a long time ... But as a matter of fact, I don't know what the other people teach, so there is no way that I can integrate what they teach into this course. I can integrate what they assume they teach into this course, but it winds up being sort of my understanding of some presumptions of what they should teach or ought to teach. We probably need ... faculty communication so that I'm more aware of what other people are teaching in their courses. We try to do that, so it's supposed to be the place where everything is integrated ... but I don't think that there's a sort of integrative synthesis kind of course in most educational programs.

The problem as prototype.-- Throughout their discussions of their teaching, as well as in the presentations of the problem to their students, these teachers emphasized the importance of treating the studio design problem as a prototype of all design problems. "One of the best ways to do it," one said, "is to teach them to study it prototypically." In fact, this view may even save students from the "dumb" problems they will inevitably confront in private practice. Indeed, perhaps "dumb problems" should occasionally be assigned in school, just as an opportunity for students to practice finding the interesting in the tedious:

> We probably ought to do more of this. If you give a dumb problem ybu've got to give it in a way that the students can see the room for their creativity and see there still is room for real creative input into a problem like that.

In discussing the present (presumably not "dumb") problem both teachers emphasized the generic qualities of students' learning with this problem. For example, one teacher explained

> you teach them not to take the specific thing that worked in one place and apply it in another; you teach them that they ought to ask themselves the same questions they asked themselves in the other place.

and he then later reflected further on showing students the power of prototypes in their thinking:

> So the student is trying to solve this problem, for this building, for this client, for this function on this site, but ... you've got to pose the problem in such a way that they see that there's a lot of transferable learning, that they're learning how to solve this problem but meanwhile they're learning how to solve problems like this, and maybe even how to solve problems apparently not very much like [this] .... I think it's one of the reasons I like to teach Urban Design; time and again you can point out that ... "Look, this isn't unique to this intersection or this road or this shopping center or this vacant piece of land. It's a problem that exists everywhere in cities all over the country. If we can find out how to solve these problems then we can apply it again and again." And that's, I think, one of the most interesting things about education: approaching problems in a kind of prototypical way ... if you can get them to see that what they're doing has not just application in this course, in this problem, or this year of their lives but it has repeated application.

This teacher recognizes, however, that although this may be the wisest way to teach architecture students -- and perhaps to function as an architect -- the focus on prototypes may work against some of the designer's instincts:

> I think there's a kind of weakness in our profession, because we're trained to look for the particular, unique kind of qualities in any problem, as a way of making our buildings different from one another. It's a way of making the task a little more interesting ... it makes the client feel they're getting a one-of-a-kind. ... But I think it's even more interesting to approach problems as if you are trying to learn in the design of this problem some things you can apply to other problems or maybe even all problems.

The latter view prevails for these teachers in this studio -- they emphasized that they were teaching through the prototypic example of this particular problem assignment. Indeed they had mentioned that the ideal problem has a generic quality and their purpose in this assignment was to emphasize the usefulness of the prototype. They had gone so far as to construct the Lynch theoretical framework to underpin the studio assignment, and to use it in presentations to and

later discussions with students. They had known that for particular studio problem to be a successful "fit" within the larger venture of teaching architecture they would need to "write the problem and talk about the problem as if it is a prototype of other problems." In sum, one teacher described how to do this:

> That's the whole idea ... the problems are so similar that if you can solve one in a slightly different way [you can] solve all of them. What you do is you pick a problem -- give a demonstration solution -- but implicit in that demonstration solution [is] that with minor variations that's the solution to five hundred other similar problems. And so what we try to do is come up with specific projects that are in and of themselves generic.

Indeed, these teachers saw the prototype as a metaphor for teaching students about solving complex problems beyond architecture. This possibility further engages their fascination with teaching:

> I think the other thing that's exciting about teaching architecture is [that] you can make analogies from that to all kinds of things -- whenever you think about anything that has to do with human choice or about the way you make intellectual categories. ... It's nice if they take whatever they learn in a college course, and if it's transferable then it's great.

Pertinence for professional practice.--Throughout this semester, the image of professional practice permeated the teachers' remarks, the problem definition and requirements, and students' concerns. Interestingly, although experience in professional practice is said to be a critical requirement for faculty members in professional schools, these faculty members never used phrases like "when I do a building" or "when I was in practice." They often did, however, point out the specific importance of techniques or ways of thinking for effective professional practice -- whether theirs or the student's. For example, in presenting the assignment to the students the third time -- when they concentrated on project details and logistics rather than on conceptual framework -- the teachers pointed out ways that the techniques being used in this problem would be important ones to develop for architectural practice. While one teacher described the project requirements, the other commented that skill in framing the context, stating the problem, and presenting ideas to clients using a flexible visual medium would all be assets for them when they began working for an architect. They would need to explain to clients how they see the problem, he explained, and what they plan to do to address the problem; in sum, they would have to be well prepared for both their designing and their communication with clients. Later, in discussing slide-fade techniques for communicating design ideas, he pointed out that architectural offices are already using this technique for client presentations. In describing the project's required presentation techniques in an interview, the other instructor mentioned that the drawing requirements were for

> some very popular presentation techniques -- ones that could be presented to large groups and have them fully understand, ... [emphasizing] models and slide presentations. And also those slide projected drawings so that people can see what you're talking about as a finished project, and experience it three dimensionally rather than seeing it two dimensionally on a plan, which is what city planners most often do.

The reality of these presentation techniques is important, they explained, because three dimensional representation is necessary in solving real urban planning problems. In his interview one teacher described his amazement that planning decisions are sometimes made from land use maps:

> these people were asked to make a decision just based on that two-dimensional image....Those are people's houses and businesses but they're content to mush around with two dimensional colored images like we're making a paper cutout.

In architectural practice, concrete representations of the problem are important also because

> you can't any longer sort of sit in a chair in a coffee shop and sort of think about the problem. You have to go where the problem is and you have to go where it is represented in your models and in your drawings in order to be able to see the complexity of it.

As previously described, these teachers were acutely aware of the important role played by concrete representations in student's learning. One commented that this is true for the practicing architect as well:

> Well, it's always difficult for students to finish projects and it's always difficult for them to start projects ... not just for them but for any designer

> They're going to have to take these people from knowing nothing about the problem to, at the end of twenty minutes, understanding the problem ... that's terrific experience for architects

Other similarities to office practice were woven into this project. For example, the teachers emphasized prototypes because

> typically a student will go into an office and the first job they get is to add a bedroom to somebody's house and the house is ugly to begin with

so teachers must show students how to think of even the most prosaic problem as a prototype of a larger issue -- presumably a sanity-saving technique with bedroom additions and other uninspiring projects.

In fact realism is an important criterion for a good studio problem -- according to these teachers' point of view -- because the problem will be more meaningful for students.

> To me [learning is] a lot more realistic if the problem is realistic; if it obviously is a problem. That's why, when I was in school we'd have problems like designing the entrance way to some sultan's estate or some baron's castle, someone would say, "now is this a really serious problem in this world?"

Simulation of architectural practice was important not only in these teachers' design of the problem assignment -- for example in presentation techniques or use of realistic problems. The teachers also managed their studio to incorporate some important features of practice. For example they carefully planned in their expectations for students' work for the students' transition from school to practice:

> It's sort of more like real life in the sense that you can't hold their hand forever. Yet, on the other hand, the expectations don't diminish. Just puts more responsibility on them. It's more like dealing with a six year old versus a sixteen year old in terms of your expectations. Certain things need to stay the same and certain things need to change.

In their interactions with students at this level they also simulated the relationships found in office practice:

> You need to sort of respect their judgement and the information that they have. In an office you sure wouldn't sit and sort of preach to the other people that are structurally under your responsibility, and tell them all that, without respecting [their feedback]. You might organize and you might come up with the first idea, but the next thing to do is sort of listen to what they have to say about it and then make the appropriate changes.

As an exception to the parallel between the studio and practice, however, one teacher described the kind of situation in which the studio can be beneficial in going beyond the requirements of practice. He pointed out that the decision making required in a particularly ambitious project can give students a broader view of design than can be seen in the day-to-day realities of practice:

> unfortunately our profession doesn't get to make a lot of those decisions; they're usually sort of handed to us.

Importance of the product.--A good studio design problem, further, acknowledges the importance of design products not only in practice but also for students' learning.

> You don't develop a design in the abstract and then figure out a way to present it. The process of presenting and drawing is part of discovering design. ... The fact that we're talking about products before they've started is an indication of how important a part of the design process that must be. Otherwise we wouldn't talk about products until they were finished.

Early in the project these teachers specify the products they expect from students. They do so not simply because they are dutifully being fair to students by specifying course "objectives," or to inject "relevance," but because development of the design product is the vehicle through which students' best design thinking and learning occurs. Designers in practice live and think through their drawings, said one of the teachers, and the problem's visual representations elicit the designer's best thinking about the problem's discovery and resolution.

Assignments for design products are therefore carefully planned. For these two teachers, the brainstorming session included a swift exchange about the most appropriate products to require of the students. While superficially the exchange might have been interpreted as a negotiation about products, in reality a discussion about products is a discussion about the best vehicle for student learning. One teacher proposed slides, including slide-fades of drawings illustrating proposed solutions; the other said "we might have to stay flexible" and admitted to preferring a three-dimensional model. The two agreed on "a principal model and required slide fades, supplemented with additional material as necessary."

In reflecting on his own teaching, one teacher revealed the importance -- for him -- of the visual, and especially the graphic, in his thinking. His remarks summarize not only the significance of the tangible product in design teaching but also the intrinsic role graphic representations play in his own designing.

> I draw a lot. And I try to draw as much as I can because I believe that's the form of architecture. I don't think architecture is a verbal art. I don't think there is such a thing as a verbal architecture idea. I think without some sort of graphic or three-dimensional model, you're just talking about words, [and] words are an inappropriate means of communication for our thing. ... I think it's really important -- to my way of thinking -- to communicate graphically. That is the language. It's not the English language. It's a graphic language that we're talking about, and if you can't draw it then I don't know what you're talking about because people will never see it in a building. ... If they don't see whatever you've designed into the building then they're not going to see it at all.

This quotation also summarizes the insufficiency, if not the absurdity, of proposing to study design instruction without studying the products through which teaching and learning occur. Studies of design instruction are insufficient if they do not address the visual elements of students' design discoveries, the visual communication between teacher and student, and the resulting representations of students' learning. Others' attempts to capture the design teaching process have been criticized because they have omitted the visual component; the same may be said in the present study, except that this study indirectly did address design products and visual/graphic representation through analysis of their role in teacher planning.

What constitutes a good design problem? -- When designing a good studio problem, teachers keep in mind what students must do to learn from the problem, they are attentive therefore to how the problem must be crafted, and they are watchful about the end product. These teachers said that a good problem requires students to analyze and then to synthesize the problem's requirements, and to communicate the problem's resolution to others. The great number of skills involved in design must all be honed throughout the curriculum; a good problem meshes with the curriculum but extends students' prior learning into new areas. A good problem is one that balances teacher-imposed direction with student initiative:

> A studio teacher's job is to first set up the sort of problem structure that allows the students to explore what they want to explore, and then work with them, relying largely on their skills as the same time relying on the teacher's experience and own knowledge

Teachers must also balance the varied skills and abilities of the students gathered in a particular studio at a particular time:

> You need to deal with the range of skills they have. You can't aim it at the top or the bottom; you have to aim it in between, but you want it so the ones at the bottom can have some success and the ones at the top can still be challenged.

One teacher anticipated this study's findings about the teacher's conceptual frame in defining his ideal design problem:

> For me the requirements of a design problem are number one something I'm interested in, number two something that they can handle, [and] number three it fits in with the sequence of the curriculum

In their work to design a good problem, these teachers considered many factors at once. Particularly in their brainstorming, but also in the interviews, the teachers simultaneously considered three factors: (1) the theory of design itself, including their intentions for student appreciation of design, (2) their conceptions of how students learn best, and (3) the logistical arrangements necessary for merging these two in addressing the task of the studio course. An observer's note from the first brainstorm mentions these three:

> As they commented on student confusion they also commented on schedules for completion of the work, etc. The discussion seemed to encompass the content of the design problem, the logistics for teaching the studio, and their thinking about student learning.

Later in the brainstorm the observer combined quotes with notes in this description of a quick exchange between the two teachers:

> K: "Are we going to encourage teaming?"
>
> C: "We get more work done when they work singly."
>
> C: further comments that three get as much done as one because of negative interpersonal interactions; someone's always mad. C. then says a problem for him is magnets. His question is, is the movement problem alone enough of a problem or should it be done with something else. But if they do that [something else], lots more detail will be required. Must make it a doable project.

In this exchange the logistics are addressed (teaming, amount of detail) within the context of students' learning (somebody's always mad, three get as much done, make it doable) while at the same time they address the conceptual implications of their theoretical structure (magnets,

movement with or without other associated concepts). The teachers shift continually throughout this content/learning/logistics "triangle" as they formulate and plan the studio assignment.

In sum, this study illustrates how the teacher's role is to design a good problem and help students through a successful solution. After pondering the attributes of a good design problem, one teacher offered a simple summary:

> They go through it and hopefully know more about their profession when they're finished than when they started. A successful problem is one where you learn a lot, and an unsuccessful problem is one where you learn very little.

Helping Students through a Solution

What, exactly, constitutes studio teaching? It rests, clearly, in the conceptual frame that a teacher brings to teaching and the design of the project assignment. The full picture of teaching is incomplete, however, without attention to actual instructional strategies -- the techniques teachers use in dealing with students in and out of the studio through the duration of the project. These strategies -- often specific techniques -- include the following:

> Making arrangements so students can engage and pursue the task set out in the assignment.
>
> Influencing how the students think about the problem
>
> Dealing with students in ways that will be helpful -- including diagnosing their progress, shaping their problem, structuring the project requirements, and interacting individually with students
>
> Both opening the problem's opportunities for students and closing or focusing their thinking
>
> Improvising as required for the entire class or for individual students
>
> Evaluating students to determine their readiness for the next course, or for graduation and employment
>
> Changing and learning

First, teachers make arrangements so students can engage and pursue the task set out in the assignment. As the third problem presentation class session demonstrated, they can suggest materials, negotiate supplies with the dean's office, suggest graphics techniques. They take steps to "unparalyze" students by requiring tangible beginning steps in the project, according to both interviews:

> first you have to get them to be able to do something kind of lock-step.

They carefully design the deadlines to permit a successful beginning and yet to urge students onward through the project, according to both teachers:

> the best way to get it going is to set a deadline

> I think the only way to get students moving is to give them deadlines. They have a hard time beginning a project so unless you give them those first one or two landmarks of where you want them to be at what time, they in fact will take two-thirds of the length of the project to get started on it.

and they give students the opportunity to present and refine their projects several times during the semester, counting on the presentations to be instructive as well as coercive:

> If you have to explain a problem to someone else, then it's a real good way of explaining it to yourself, which is really what they need to do ...

Teachers work within a variety of constraints, as we have already seen -- the curriculum, the students' abilities and progress, the project the teachers have selected. Among the most important constraints to be managed is time. All design teachers know that students start projects slowly and finish them in a final burst of late-night effort. Getting students into the project is not only an intellectual challenge but one of time management as well:

> They're asked to get into the problem quickly. You know, time is time, and the first week is exactly the same amount of time as the last week. By the time the last week comes around they will have been very grateful for not having wasted two or three weeks.

Once students are "in" the problem, deadlines are used to move them along through the problem as well:

> So we try to give them some very specific deadlines and some projects to work on that will get their feet wet real soon and get into that middle stage of the project where the meat and the work will occur.

Teachers must also manage their own time, finding strategies to maximize their studio hours

> We just don't have time with this many students to get around and [explain] to everybody. Actually the thing that helps also is the iteration of their having to do it three times. ... We just don't have as much time as would be nice to have to criticize ... to give a lengthy critique to each student ... we have to rely on the fact that we present the opportunity to go through it three or four times and hope that will be adequate.

Because teachers have limited energy and the semester is all too short, they must be efficient in their use of time:

> Sometimes we have bad days, you know, but the good thing about it is you have fifteen weeks ... and if you can arrange to use that efficiently at all then there's time

Time is important also because in the studio, time spent on a project can be confounded with effort devoted to it. The teacher must distinguish among students' effort, abilities, and available time:

> Then you have to find out it if was a matter of understanding or just lack of effort ... you have to look behind that ... because sometimes the student is working 30 or 40 hours a week. Sometimes it's a miracle that they even did as well as they did.

A second important component of in-studio instruction is the teacher's influence on how the students think about the problem. As has already been illustrated, these teachers emphasized seeing a problem as a prototype of a broad classification of problems:

> You've got to pose the problem in such a way that they see that there's a lot of transferable learning -- that they're learning how to solve this problem, but meanwhile they're learning how to solve problems like this ...

This is accomplished by showing the students

> that you think the problem is important, and that you think that it's valuable to learn how to solve problems like this

and by engaging students' minds in the problem

> in some kinder of deeper way. It's a lot better if they can see it somehow as part of a larger process.

Part of influencing how students see the problem is in giving them confidence that skills they previously learned will apply in new ways to the new problem. In the last year of the curriculum the teachers change the nature of the problem assignment, but as a "confidence builder" these teachers remind the student,

> "now wait a minute; it's not always going to be the same, but look what tools you can bring from what you've been learning to this new situation."

One teacher elaborated: a teacher must "just explain it as clearly" as possible, must try to

> get them to understand the framework of what you're trying to do ... explain it in all the ways you have at your command

The other teacher explained further about explaining:

> The other way that I think is good is to describe it to them [in] as many ways as you can. Talk about it different ways. Show them pictures. Write about it. Take them to see it if you can.

Following this, one of the important roles in studio criticism is to

> help them with a method, with the design process; you have to tell them that they ought to do this or they haven't done that or that they ought to try this, so that when you walk away you not only leave them with suggestions as to what to do but you leave them suggestions of how ... and if you can you give them three or four ways of doing that.

Additionally, drawing upon their background as experienced designers, they respond in their teaching in ways that can help students; one teacher explained that he will

> tell them some ideas I have about the problem ... I always wind up just responding to the problem myself and letting the students know all my responses to it right away.

Moving beyond their own personal response to the problem, the teachers also offer other examples and demonstrations:

> You give a demonstration solution, but implicit in that demonstration solution that with minor variation that's the solution to five hundred other similar problems.

As one device for showing students that each problem might have many solutions, these teachers planned the review sessions to reveal the disagreements that informed, committed professionals can have about a specific urban design problem:

> And I think the students will see some of this, because we're actually going to try to get some people who'll disagree on these [reviews]

Teachers not only influence how students initially envision the project assignment, but also continue to deal with the students in ways that will help them make progress toward a solution. The teachers spoke of teaching as a diagnostic process, for example when they cannot determine whether the student is unable to understand the problem or is not giving it enough effort; sometimes, too, they are wrong:

> many times we mis-assess where the student is or how much they understand. But you're constantly trying to get a handle on that -- how much they understand.

Teachers use some structural techniques for gleaning the best from their students: both in their interviews and in presenting the project to the students the teachers mentioned the importance of high expectations, and in the interviews they confirmed that they give students at this level "lots of responsibility." They depend on varied products (models, renderings), as previously mentioned, both as a vehicle through which the students' thinking develops and as a mechanism for moving students along in the project. The multiple presentations were, of course, also designed as a means for students to move ahead and to continuously refine their work.

Both teachers emphasized also that they themselves play an important role in shaping the problem for the students. Both mentioned that they want to ensure success for all students:

> the goal in any design problem for both the teacher and the student is that everybody in the class succeeds over a certain threshold
>
> You want to give them as much of an opportunity to succeed in the project as you can.

To accomplish this teachers sometimes need to steer students into projects they think they can handle and away from hazardous approaches whose pitfalls they can see but the student cannot foresee. They "constantly redefine" the problem for students, at some times broadening the student's vision and at other times narrowing the focus.

In their personal interaction with individual students, usually in desk crits, the teachers further shape individual students' projects. In their brainstorm, for example, they agreed that with certain kinds of questions sure to arise,

> we can be helpful with a specific site with a student over a desk

They affirmed that they can loosen the requirements or steer individual students in fruitful new directions in individual critiques but they would not give these suggestions to the entire group, lest the students see them as a mandate. In dealing with individual students they will

> communicate a kind of enthusiasm about the problem and tell them all the opportunities you see in the problem, and that can be dangerous [because it might restrict students' vision]

They fully expect good ideas from their students, and see their role as improving on those. They explained that

> you've got to critically respond to what they do; the best way is to make positive suggestions, not just tell them how bad it is and walk away. So you leave them with something, and not just one suggestion but if you can, three or four suggestions ... you want to try to find some ideas that are their ideas that they contributed

The other teacher pointed out that the students' ideas at this level deserve careful thought:

> You need to sort of respect their judgement and the information that they have ... [you] listen to what they have to say about it

At the same time the teacher pushes students beyond the work they produce into new directions, even when students are having problems. When asked how they manage the studio when students are having unexpected difficulties, one explained

> It's a difficult problem for them, but you also see leaps and bounds in their learning -- so even if it appears to be a failure it's not. In fact it's a dramatic success.

Perhaps the single most vivid theme in this study's findings is the teachers' fine balance between "opening" the problem -- the possibilities for the students -- and "closing" or narrowing the problem for them. From the start, in their brainstorming session, the two teachers agreed (in

the words of the observer) that while "they needed to get students into the next part of the problem, yet there was a need to hold off a little" and see where they would need to "reconceptualize the task for students when the situation is ambiguous for them." On the one hand they must help students focus, while on the other they must keep the possibilities open.

Students themselves are one reason for the need to balance opening and closing. One teacher explained that some students require "closing" while for others the teacher needs to open the problem. His metaphor for this illustration portrays a new design problem as a building with many doors. Some students keep opening doors and seeing new possibilities, while others do the opposite:

> They go to the next building and they just keep opening doors. They're what somebody calls divergent thinkers. ... They keep discovering things, but you have to really work with them to get them to close the problem, to finish and actually do something. And others just open the front door and say, "oh, I know what this is; it should be round and eight stories high," and those you have to give techniques to reopen their mind again and again.

The other teacher explained about students in another way. Early in the project,

> They're having a little bit of difficulty defining their problem. There's a general tendency ... to shy away from problems that seem to be open-ended and difficult, and so they'll kind of latch onto something they know a little bit more about.

Working with -- not against -- this "general tendency" is the teacher's most delicate challenge. The teachers explained that they manage this challenge first in their design of the overall studio curriculum (as previously quoted), and then in the way they portray this curricular design to students:

> by this year ... we begin to change the problem ... a whole bunch of things might have changed but remember what is the same

and finally, they manage the challenge in their design of the specific project assignment:

> I think anytime educationally you can <u>hold a few things the same but change almost everything else</u> and have students apply their knowledge, their abilities, their sort of intelligence in a completely different situation that they've never had before, that is a tremendous confidence builder and really good for their intellectual flexibility

Another view of the open/close theme arose in the teachers' explanations of what constitutes a "tough" assignment. The concept of a "tough" project gave us one of the most charming metaphors of the study. One teacher gave us first an explanation of why an entirely "open" assignment is difficult, and then illustrated with a personal example.

First the explanation about "open" problems:

> The so called "tough" design problems are ones where you have so many requirements, so many problems to solve at once, that it would seem to be a very tough problem. [But in truth] it's typically a very easy problem, because every time there is a new requirement it eliminates whole group of solutions. ... I guess ultimately if you put enough requirements then there is only one solution and it's actually pretty easy to design. The really tough design problems are the ones that have very few limits and very few requirements, in which case there are many, many, many, many more solutions. ... Maybe a hospital is a lot easier because the requirements are so severe that the designer simply needs to find the handful of ways to solve that problem. So I guess the more open ended a problem, the more difficult it ultimately is.

and the personal example:

> [When I was an undergraduate junior in a department of visual-environmental studies] we were all excited to have this great and illustrious artist in studio. We were used to having very tightly structured design problems. He walked in the first day of school and here were thirty student sitting at their desks. He walks in holding a cigarette in a sort of very European way and he said, "Problem Number One is to make something very beautiful and very perfect." And then he walked out. That was problem number one. That's a hard design problem -- you know what I mean? It's a very difficult design problem because you have no requirements. ... We all fell off our chairs at that point. We had no idea what to do. I guess that's what I mean about difficult problems and easy problems.

Apparently this teacher survived the illustrious artist, although with a heightened awareness of how design can be difficult. He described one method these two teachers have used to help students deal with difficult problems -- in this instance problems that are difficult because they are unstructured. They first have them wrestle with the broad problem, then focus on a prototypic solution, then broaden that solution. This process, he acknowledges, is not easy for students:

> We try to set up what we called the "bow tie" model. A bow tie obviously is wide-narrow-wide. We asked them to look at a problem in a very general sort of way -- the wide end of the bow tie. And then in order to study that sort of general problem we asked them to come up with a prototypical and specific example, and then study that particular circumstance. And then after having done that to re-generalize that solution back to the other side of the bow tie. They had a hard time doing that. They had a hard time understanding how you get from the general to the specific and an even more difficult time understanding how you get from that specific back to the general.

In the present project, the two teachers carefully designed the task to present students with new, unstructured requirements -- to be an open task:

> one, it's difficult because we're asking them to work in an area (Urban Design) where they haven't really done work; and number two, we're asking them to both formulate the problem and solve it, and they haven't had a whole lot of experience in doing that
>
> they'll also be working in an unfamiliar medium ... building models and slide projected perspective drawings -- and they won't have a floor plan to fall back on, or some of the conventional architectural drawings
>
> the problems we're asking them to do are not only problems they haven't done before but often problems that no one's done before
>
> We're asking them to make a decision about a project and they really don't know where it's headed or in some cases neither do we

What, then, do teachers do to help students through their resolution of these unstructured, difficult design problems? In a word, they strike a fine balance. In the context of explaining why teachers must remain open to students' ideas, one teacher explained the balance between structure and flexibility:

> [Interviewer: That's why you have those stages (several presentations with refocusing); that's why you don't close the problem?]
>
> Right. You just try to leave it as open as you can afford to leave it, without threatening the structure of the whole thing [i.e. leaving students with no idea of what they're doing or why they're doing it] but close it enough so that they can understand it.

The brainstorm session provided a tangible example of this balance. For students choosing an easier site, such as a vacant lot, they decided to elaborate the assignment by requiring that the students produce several alternative solutions and a comparative analysis, since dealing with vacant property is typically easier than dealing with a site already built upon.

Particularly at the start of the problem, the teachers held the problem open, particularly in the face of student pressure for closure. Even in their simplest arrangements for student choice of project categories (magnets, radials, vacant property, etc.) they left the possibilities open:

> I want you to raise your hands guessing what will be your choice -- then we'll go over the detail of what you would do for each; then we'll go back to see if in over-booked categories people will change their minds. It would be nice if you were flexible as to location.

They also teased students about their incessant pressure for detail:

> Student: Are you going to go into specifics for this assignment?
> Teacher: Do you want blurbs? Do you want to ask?

This is not to say that the teachers, in holding open the project's possibilities, withhold essential information from students. They provided expectations, however, rather than prescriptions for the students' approach and their work, and gave advice rather than requirements:

> Student: Are we supposed to suggest more than one?
> Teacher: You could indicate three areas, then detail one. Doing this would give more credibility for the others.

In another example of balance between the open problem assignment and the students' need for detail, the teachers responded to student curiosity about final reviews by explaining that there will be teams of outside reviewers with expertise in the project's several areas who work with students on the issues. This response satisfied student uncertainty about the reviews, but left open the logistics and procedures for evaluating student work.

Examples provided another technique for balancing opening with closing. The teachers gave concrete examples of the factors students could deal with in each aspect of the project, but by using a cascade of examples they were inclusive rather than exclusive in prescribing any particular approach. For example, in describing neighborhoods, they suggested (among other things) that roadways and drainage could be redesigned so rain runoff could go to storage for common use, they asked how land surface could be changed and used more efficiently, and they asked whether the price of a dwelling should be the only factor in residents' choices of neighborhoods.

In another example, they moved their discussion of magnets from large scale neighborhoods to the smaller scale of a convenience market. One teacher said "you can come way down in scale like a Circle K, but don't try just one -- why not try several?" In this example, by expanding from one to several markets, the teacher reopened a problem that would be too narrow if left as a single market.

One teacher described the way he used prototypes with the class:

> What you do is you pick a problem -- give a demonstration solution -- but implicit in that demonstration solution, with minor variation, that's the solution to five hundred other similar problems

The teachers used group meetings to expand and continuously redefine the students' vision of the project's possibilities. In individual discussions with students, on the other hand, they worked with the student to shape and narrow the project to suit the student's abilities and interests, as previously discussed. One teacher said he will

> communicate a kind of enthusiasm about the problem, and tell them all the opportunities you see in the problem

and also

> describe it to them as many ways as you can.

An important part of teaching for these two teachers is refocusing the problem for each student as necessary. Both teachers emphasized this refocusing when discussing the students' three or four opportunities to present their problem and their proposed resolutions of it:

> and each time, if we work it right and if we can find the time, we will refocus the problem

Refocusing the problem takes a different character with each student:

> Sometimes people solve the problem the very first time or the second time. So then we have to open up some other problems that are tangential to that problem, and say "look you've got that fine, but why don't you think about this, or could you do this." Or -- we'll push them to make a little bit more sophisticated presentation or communication of it.

In each case, however, the goal is maximum learning for the student:

> We have both problems [projects to be narrowed and those to be broadened] but in each case, in every case we can, we sort of restate the problem and always with the hope, if you're lucky, of having the best possible result in the end.

The problem is open not only for the students but for the teachers as well. Both mentioned that there are no solutions for some problems, and for others there may be solutions they themselves have not foreseen:

> Some of [the projects] we don't have many ideas about. We may recognize that they're a problem, but we honestly don't have any solutions.

In these situations, as with their work with students, the teachers said they depend heavily upon their ability to improvise, to find the best balance between opening the students' perceptions and focusing their attention as the project evolves. It is not surprising, therefore, to find that the important theme of opening and closing the project was linked to the teachers' descriptions of their improvisation in teaching.

Much of skillful teaching is <u>improvisation</u>. The more senior teacher gave us our most vivid metaphor for improvisation:

> Well, like Harrison Ford said in one of those movies, "I'm just making this up as I go along." You know, after one of those incredible sequences.

Throughout the study this teacher illustrates how "making it up as you go along" works. As for Harrison Ford's film character, for teachers "making it up as I go along" is a process based on

vast experience, skill, knowledge, and the ability to assess and respond to complex circumstances.

Asked about students' early difficulties with the project just getting underway, the teacher "making it up" replied

> It's a little too early to know yet. We'll know much more after this first presentation.
>
> [Interviewer: so what you're saying is that you're concerned about this first presentation -- you have some ideas about how to start them into it, and yet you really aren't going to know --]
>
> Yeah, and that's okay.

Indeed, improvisation is not only "okay;" it is expected, and even desirable, and therefore planned for. As the second teacher explained,

> Well, we wing it a lot of the semester. We've worked together for awhile, and we find if you make too much fixed early on, you can't make any positive use of the information you get all along. So, as you can see, we make decisions as they come up, based on the feedback we're getting. ... So really what we do is try to be specific as we have to but no more so, and then you try to hold off on the next decision until any additional information comes in. And that seems to work out for both of us.

For these teachers, improvisation is not only the best way to teach; it is also an integral part of the way they see the design process -- even in their own designing:

> Because some of the things just happen, you know. I see something in the drawing I'm making that was unintended, but I see a way of making a relationship because of some other things I saw -- out of memory -- completely below the level of my consciousness. I see some ways of putting things together that I hadn't seen before.

This description, although expressed in the architect's language, is familiar to all whose work emerges from within their thinking; the products of art, architecture, writing and a host of other creative fields -- including teaching -- evolve this way. Indeed, this teacher explained that attempts to analyze the design process can never be fully successful because such analyses can never fully account for revelations emerging during the process itself.

> I don't think there is anything wrong with analyzing the process into parts and maybe even talking about a desirable order that you go through. But I think ... we're trapped in a pseudologic where I try to tell you after the fact why I did a certain thing when in fact I don't have any idea why I did it.

He might have been describing the teaching process as well. A teacher relies on improvisation, on revelation, on uncovering the essence of particular students' learning in the particular project and expects to be able to make adjustments along the way. As one teacher has been quoted above as saying,

> It's a seat of your pants kind of thing. There's no formula for how to do that.

Both teachers mentioned grading students but did not dwell on the difficulties that grading presents in this advanced class. One teacher summarized his views on grading: "grading is an inexact art which has to be very consistent."

These teachers saw grading in competition with two important educational principles: their resolve to ensure that every student would have a successful project by the end of the semester, and the almost impossible requirement that the student's work be separable from the teacher's contributions

> You know, it's a delicate balance. You want to make sure that ultimately it's the student's project and that it's the student's responsibility; on the other hand you want to give them as much of an opportunity to succeed in the project as you can.

Lastly, in discussing what they "do" as studio teachers, both teachers alluded to influence of their teaching on their thinking. Both mentioned that a teacher must

> listen to what they say; if what they're saying is smarter than what you can come up with, then you'd better be flexible enough to change.

and teachers must be prepared to

> change our minds, because the student actually understands the problem better than we do, or has some insight that we didn't have.

And in the end what teachers "do" is as much private as it is public; teachers make discoveries for themselves throughout their teaching, finding that "these sorts of discoveries are really exciting to me," as one teacher put it.

Indeed, the entire process -- from the broadest conceptions of design teaching to designing a good problem and helping students through it -- is a process of discovery for the studio teacher. This discussion turns next to examine how the patterns of these discoveries mesh with the existing theoretical and research literature on teaching.

Conclusions about Design Teachers' Thinking and Planning for the Project Assignment

From the perspective of the study's initial theoretical foundations, the 27 separate findings about studio teachers' teaching and planning form three major groupings: (1) patterns of teachers' knowledge and reflection, (2) findings about the academic task -- the design problem that constitutes the studio's focus, and (3) teaching and learning as a balance of openings and closings.

Teacher Knowledge and Reflection

This study began with the teacher thinking literature because we believe, with Clark and Yinger (1979), that what teachers do is affected by what they think, and therefore that investigating teacher thinking is crucial in understanding teaching itself. Citing many other writings on teachers' thinking, Mitchell and Marland have more recently (1989) pointed out the gaps in research on teacher thinking, noting especially the narrow range of teaching activities about which teacher thinking is typically investigated. This study sought to fill several of those gaps by turning the focus to teachers' thinking in postsecondary education, which only Stark and her colleagues, and to some extent Donald's work, have explored. Mitchell and Marland also point out the inadequacy of early models for teacher thinking, notably the decision making paradigms currently in vogue. They propose, and we agree, that "a worthwhile direction for research lies in identification of schemata used by teachers to guide their information-processes and actions in classrooms" (p. 127).

Our own previous research on in-studio instruction (Dinham, 1987) had suggested the importance of such schema. Teachers' views, knowledge, beliefs, and reflections on them in their thinking about instruction as well as in instruction itself emerged in the earlier work on teachers' over-the-desk studio instruction; for example one theme was entitled "philosophies/views manifest in teaching" and another dealt with the teacher's perceptions of teaching and learning. While these themes arose from studies of student-teacher exchanges in the studio, they foretold the importance both themes would occupy in teachers' planning for their design instruction.

The previous work (Dinham, 1987) offered a "map" (Figure 3) in which the various previous studies of studio teaching could be located. The map's central placement of the teacher's epistemology, knowledge structures, beliefs, and content representation was verified in the present study; these factors influence not only student-teacher exchanges -- the focus of the earlier work -- but also, logically, teachers' instructional planning as well.

The present study unfolded more fully the first segment of this "map," the knowledge and reflections teachers bring to their teaching. Shulman (1986, p. 26) has distinguished among three kinds of teacher knowledge: subject matter knowledge, pedagogical knowledge (which since has come to include knowledge about students), and curricular knowledge. The first two, if taken very broadly, account for much of this study's insight about teachers.

The teacher's conceptual frame may be said, for example, to include not only the philosophies and beliefs that the teacher brings to teaching -- the world view previously described as social commitment and beliefs about urban development -- but also much of what Shulman calls subject matter knowledge -- teachers' conceptions of architecture itself and of the design process, the impact that such a studio can have upon the community, the ways these can be woven into the design problem.

Given the importance of disciplinary imbeddedness in decisions about teaching strategies, it is not surprising to have found in the present study that most explanations of the teachers' thinking about instruction were expressed in the language of the field being taught, and

illustrated in its metaphors. This being the case for urban design, we can concur with Donald (1986) that disciplinary differences in the nature of concepts, logical structures, and truth criteria would be crucial in determining disciplinary differences in teaching strategies.

But the talented teacher is more than "knowledgeable," even broadly defined. As Schon (1983, 1986) has argued, the accomplished professional reflects on the professional practice (in this instance the practice of teaching) even as it is underway. The findings of this study evidenced complex and continuous reflection by both teachers on their thinking, their planning, and their instruction in the studio.

Teachers accomplishing this goal exercise judgments of vast diversity and complexity. Research on teacher judgment, summarized by Clark and Yinger (1979) has revealed useful ideas on how teachers' judgments influence planning, how they shape teachers' conceptions of effective teaching, how judgments influence students, and how they affect teachers' instructional strategies. Likewise, the present research identified ways that teacher judgments influenced their planning

> You just try to leave it as open as you can afford to leave it, without threatening the structure of the whole thing, but close it enough so that they can understand it,

and their conceptions of effective teaching

> I think anytime educationally you can hold a few things the same but change almost everything else and have students apply their knowledge, their abilities, their sort of intelligence in a completely different situation that they've never had before, that is a tremendous confidence builder and really good for their intellectual flexibility.

Teacher judgments about students also influence the way they deal with students in the instructional studio:

> They go to the next building and they just keep opening doors. They're what somebody calls divergent thinkers ... They keep discovering things, but you have to really work with them to get them to close the problem, to finish and actually do something. And others ... you have to give techniques to reopen their mind again and again.

The teacher making these judgments consciously, pondering the judgments and their consequences, fits the picture of the "reflective teacher" variously described by many who have recently been taken with this term. In reviewing the current conceptions of the "reflective teacher," Calderhead (1989) classified the ways in which these conceptions vary; he saw variation in the ways those studying reflective teaching view the process of teacher reflection, reflecting teaching content, its preconditions, and its products (p. 44). In the present study, that variation in what constitutes "reflection" on teaching emerged even within the teachers under scrutiny, suggesting that more precise investigation of teachers' reflections is warranted.

This study's findings about the teacher's conceptual frame included not only subject matter knowledge but also pedagogical knowledge. A vision of curriculum emerged as one of the strongest pedagogical themes. Among the varied conceptions of curriculum identified by Eisner

(1985), one conception dominated these findings -- the curricular orientation that might be termed "development of cognitive processes." In some quarters this view of curriculum is expressed as "teaching them to think." More developmentally speaking, the intention may be seen as "learning how to learn," where the teacher's (or the curricular) responsibility is to provide opportunities for students to use and strengthen their intellectual faculties. The emphasis is not so much on the "content" of the subject matter -- in this instance architectural design -- as on the processes of learning to inquire and to reason, the assumption being that the cognitive processes required in designing can be cultivated.

The problem-centered design studio curriculum suits this conception, as other researchers have noted (Kendall, 1989; Nadler, 1989; Portillo & Dohr, 1989). In the present study the two teachers revealed both in interviews and in their work with students that their chief goal was to cultivate certain intellectual faculties in their students. From this point of view, the design studio curriculum is an "invention" to bring these developmental processes into play, and to strengthen them through the academic task known as the "project."

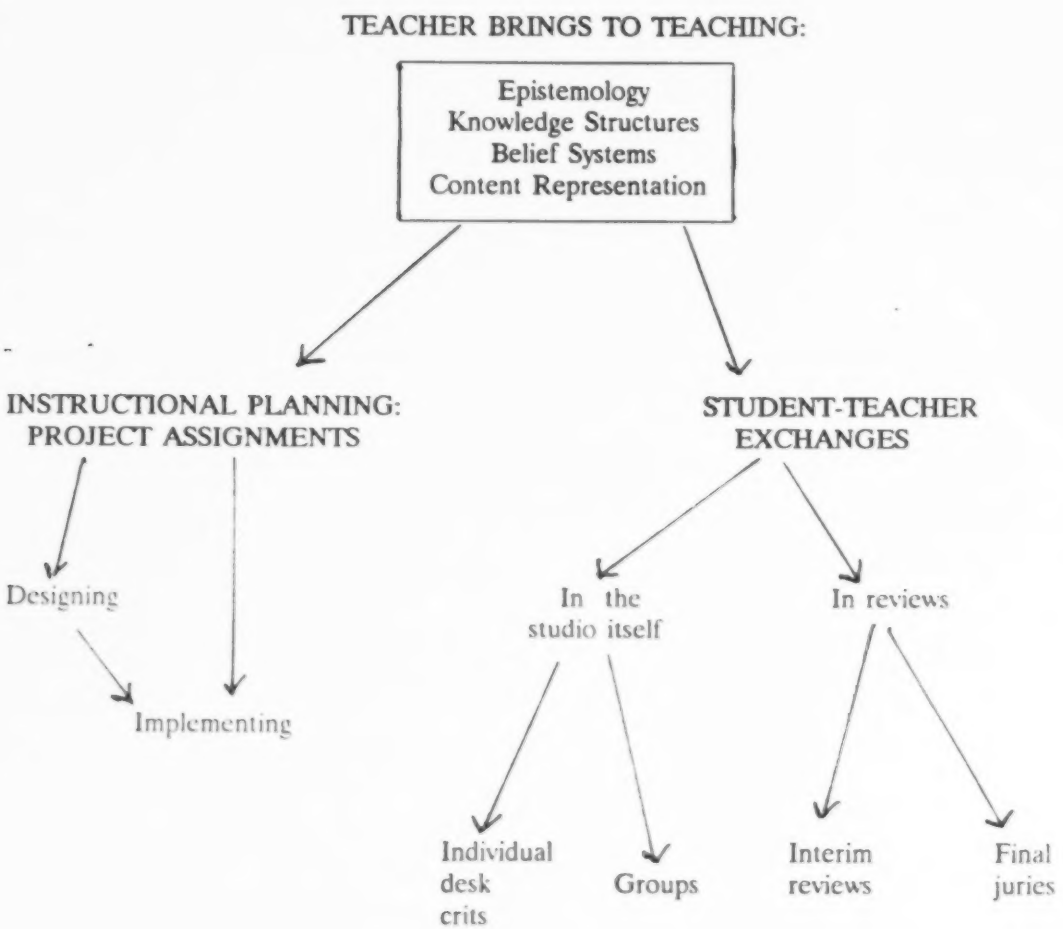
Pedagogical knowledge in its broadest conception includes not only curricular knowledge but also several other forms of knowledge that emerged in this study. For example, the teachers demonstrated a deep understanding of the students themselves. Pedagogical knowledge includes awareness of the risks and rewards of teaching, too, including the costs to teachers; it includes as well the teacher's reflections on how teaching this particular studio at this particular time fits into the larger curriculum and indeed into in society at large. Pedagogical knowledge underlies studio instruction -- its instructional techniques, its logistical arrangements, its improvisations. Pedagogical knowledge is integrated with subject matter knowledge when in planning teachers move throughout the "triangle" described above: the conceptual issues being taught through the studio problem, the students' understanding and learning process, and the logistics of instruction.

Teacher judgment and reflection are both based on deeply held understandings about the field of instruction, in this case urban design. Carter and Doyle (1987) comment that the purpose of research on teaching might therefore be to make explicit the implicit knowledge that teachers use in their teaching. The findings of this study both confirmed Carter and Doyle's assertion that teacher thinking about teaching is knowledge driven, and also separately identified a variety of elements in that knowledge base that were found to influence teaching. We discovered also, with Smith and Neale (1989), that in addition to knowledge about the field of instruction and general pedagogical knowledge, "teachers' beliefs about how particular content is established and accepted as knowledge in the discipline, and about how it should be taught and learned, play a significant role in their teaching" (p. 3).

The Project as the Academic Task

In the end, the teaching strategy of the design studio is the project. As Doyle (1986) has proposed in offering the concept of the "academic task" as an analytical tool for studying instruction, the knowledge that teachers seek to develop in their students is manifest through the tasks teachers present to students. Tasks communicate the curriculum to students, he proposes, and, thus, tasks shape their learning in fundamental ways (p.366).

Figure 3: A Map of Architecture Studio Instruction (Dinham, 1987)



This study's findings about the design studio project illuminated the academic task as the vehicle for learning. It became clear very early that teachers design academic tasks not purely mechanically but in ways that reflect their conceptual frame. This interweaving of the conceptual and the tangible was recently addressed in a discussion of generalist vs specialist positions on cognitive skills by Perkins and Salomon (1989) whose work implies for the present study that teachers' conceptual frames and the principles guiding their design of academic tasks function in close partnership, a partnership that deserves minute investigation.

Why is the academic task so important? In design studio teaching, even more than in other kinds of college teaching, the project assignment is the focus of the instruction. Not only because the design professions today are product-oriented, but also because of the field's own origins in the atelier, the studio is the focus of the curriculum -- for better (Beckley, 1984) or worse (Rapoport, 1984), and the project is the focus of the studio.

What does this focus mean for students? As Doyle has said, the tasks teachers give students communicate the curriculum, shaping students' conception of the field and of the expectations for their learning (1986) -- both being conceptions of the utmost importance for students. Academic tasks provide the setting that governs student information processing (Doyle & Carter, 1984). Moreover, particularly in professional fields, knowledge is "situated;" that is, it is folly to assume that conceptual knowledge can be learned with any depth and retention without attention to the situations in which it is learned and used (Brown, Collins & Duguid, 1989). In the design studio, the project is the academic task, the situation in which that learning takes place. Particularly in tasks requiring students to produce solutions to ambiguous problems, rather than merely reproducing already established information or applications, task design is acutely important.

This is not new information to experienced teachers. In the early 1970's, Zahorik's research on teacher planning in public schools showed that "the kind of decision used by most of the teachers concerns pupil activities" (Clark and Yinger, 1979, p. 235). In fact, even in postsecondary professional education some attention has been given to the question of what constitutes a "good" project. In a thoughtful report on engineering design projects, for example, Chalk (1984) offered specific criteria for nonroutine engineering design projects that echo the present study's findings about projects; a good project, he said, should be realistic, present opportunities for synthesis, be open-ended, should tap important aspects of the field under study, and should (like professional practice) require teamwork.

What does the studio focus imply for teachers' thinking and planning? First, this study's teachers made clear that the academic task -- the project assignment -- is itself an integral part of designing:

> If you can get an accurate representation of the problem, or better yet multiple representations of the problem, and just show it to yourself ... you can literally "see" the problem.
>
> You have to go where the problem is and you have to go where it is represented in your models and in your drawings in order to be able to see the complexity of it.

> The process of presenting and drawing is part of discovering design.

The task is also, of course, the focus of professional practice, which the studio in some respects is designed to emulate. In professional practice, not only do drawing and model building contribute to designing, but they also are the means for communication among practitioners and with clients. The task of presenting professional work is therefore crucial to successful practice:

> If you have to explain a problem to someone else then it's a real good way of explaining it to yourself, which is really what they need to do in this first phase [of the studio project]
>
> And that's terrific experience for architects,

a view teachers echoed when presenting the project to the students. They emphasized how skill in framing the context, stating the problem, and presenting ideas to clients using a flexible visual medium would all be assets when they began working.

Because the task is an integral part of designing itself, and is the focus of practice, it cannot help but be crucial to design learning. This study revealed many characteristics of a well-designed academic task: it serves multiple goals, is theory-based, meshes with and builds on other curricular elements, is crafted to guide students' thinking about the design process, is prototypic so students can extrapolate from it, encourages student confidence and produces successes, and provides a vehicle for students to display (as well as to develop) their thinking for teachers and others to see.

Thought about the academic task is therefore thought about the best vehicle for student learning. Effective studio teachers will understand this and understand, further, exactly how the project assignment functions in students' learning. This study implies, for example, that in designing a project to motivate the greatest student learning they will balance multiple opportunities to succeed or fail against the requirement of a polished, professional final product. They will plan to develop students' thinking through graphic representation; they will recognize the importance of a realistic project, and most important, they will understand the balance between opening project opportunities for the students and closing down options that would lead students in unproductive directions. In helping students through their solutions, they understand the role of "getting started," as this study's teachers described it, and appreciate the reasons for students' natural tendency to negotiate reduced task ambiguity by demanding certainty. In their work with individual students their guidance will extend from making logistical arrangements for the studio's tasks to be accomplished to dealing with students individually in ways that will expand their thinking. Throughout, the task is the vehicle through which students' learning develops and expands.

Some curriculum specialists find the notion of "academic task" offensive. One reason for this objection might be that the term "task" can signify the most routine and mundane of activities; this argument has been conclusively refuted in the present study, which demonstrated the subtle complexity of the academic tasks these students undertook. Another reason for objection to the term "academic task" is that it is often associated with terms like "academic work," in turn conjuring up factory-like images of schooling. Again, this objection, raised most recently by

Marshall (1988), has been refuted in the present study through its revelations about the creativity and complexity of thinking elicited by the carefully crafted academic task of the urban design project.

Design of academic tasks is a delicate matter, and coaching students through them is delicate as well. Teachers know, for example, that in addition to crafting the assignment itself, they must create the setting for its successful accomplishment, including arranging the timing of its progress and specifying expected interim and final outcomes for the task. These and other "teachers' tasks," deserve as careful scrutiny for higher education as they have recently received (Doyle & Carter, 1984) for classrooms of younger pupils. The present study, in discussing ways teachers help design students through their project solutions, has made a start.

Academic tasks of any complexity whatever always present the twin challenges of risk and ambiguity, challenges described convincingly by Doyle (1986) and Doyle and Carter (1984). For postsecondary professional education as well as for classrooms of youngsters, "it seems reasonable to expect that the actions of teachers and students in managing ambiguity and risk will affect the nature of the academic work that is accomplished" (Doyle & Carter, 1984, p. 131). In the present study, these twin factors -- and especially task ambiguity -- substantially influenced both the way teachers planned for the studio assignment and the responses students gave to it. Doyle proposes that teachers can constructively, intentionally include a carefully designed ambiguity into academic task assignments, in order to accomplish certain goals. The study's two teachers did exactly this, as the findings demonstrated. Doyle and Carter's research showed further that as tasks were pursued in the classroom, "there was a clear drift toward greater explicitness and specificity of judgments students were required to make on their own," as teachers clarified and specified "the features of an acceptable project" (1984, p. 145). For this study's teachers this drift was expected, and indeed was part of their strategy for dealing with students of individual abilities individually -- and particularly for dealing with students having problems.

The balance of ambiguity with focus, and risk with certainty, occurs in all classrooms. Students will "influence task demands directly by asking public and private questions about content and procedures" (Doyle & Carter, 1984, p. 145). Sometimes the questions are disguised; for example, Fong (1987) points out that when college students ask "Will this be on the exam" they often are really saying "This is an important point, isn't it?" Students do consistently, whether indirectly or directly, seek to reduce ambiguity and risk by clarifying task demands and seeking feedback about their work.

Balancing these factors becomes the core of teaching through academic tasks. On the one hand, students learn better through tasks that present challenging ambiguity because they must learn to think on their own; on the other hand too much ambiguity not only impedes learning but brings discouragement. The teacher's dilemma, even in a virtually risk-free environment like the senior design studio, is that with reduced ambiguity the task can swiftly lose its instructional merit. "If one accepts the view ... that learning to be an expert requires that students make real-life interpretations and decisions, then familiarization of novel work is a cause for concern because it truncates the curriculum (Doyle, 1986, p. 374). Students whose task requirements have been simplified may be able to accomplish the task more easily but opportunities for

challenge are lost and students are robbed of the opportunities to rehearse confronting the complexities of professional practice.

The teaching challenge represented by this balance we have termed "openings and closings," drawing from the open- and closed-door metaphor offered by one of our study teachers.

Openings and Closings

Findings about "openings" and "closings" pervaded this study, from the teachers' views of design and designing through their awareness of teaching's risks and rewards to their most complex appreciation of students' learning.

Teacher Conceptual Frame.-- The views brought by these teachers to their studio could be termed the broadest of conceptions about design's role in the greater social order. Yet in the instructional studio these views became focused on specific student approaches to urban planning -- the framework brought by the Lynch paradigm, and the structure of the specific tasks the students attacked. One teacher expressed the balanced openness and focus of the design professions when he commented that so often designers are "trained to look for the particular" in design problems, while it would be better not only for students but for all designers to find things "you can apply to other problems or even all problems." Indeed, as illustrated throughout these pages, designing was described in both global and specific terms, with both global and specific consequences for the instructional studio. Design was described as cyclical, the studio described as a set of contradictions ("naive and sophisticated, demanding and laid back") and design difficulty equated with ambiguity -- with analogies drawn from design to other aspects of life.

The Experience of Teaching.--Teachers describing the rewards of teaching emphasized the ways their experiences with students opened their perceptions; they mentioned that they, too, discover and learn, and draw new conceptions from the discoveries in their studio. These opportunities are balanced by risks -- teachers cannot always know where their studio project is headed, and must at some point relinquish control over their students' products, no matter how public the outcome.

Understanding Students and Learning.-- A project with such open goals as "perceptual change" and "discovering the community" presents many opportunities and at the same time requires students to focus. The teachers described students themselves as ranging from very open "divergent thinkers" to very focused. These teachers not only explained in interviews their understanding that for students the studio task was difficult in its openness, but in their presentations to students acknowledged student difficulties and reassured students that specificity would come soon enough, and with it closure and more certainty.
Students worked repeatedly to obtain that specificity and with it the greater comfort of certainty.

Designing a Good Problem.-- There are, said both teachers in this study, many ways to organize a curriculum; even curriculum design is open to interpretation. Yet ultimately one curricular structure must be selected; in this case the senior design studio presents not a single design problem as in previous studios but a host of problems imbedded in a complex and unstructured setting presenting multiple goals and implying multiple purposes for the studio project. These forms of openness were revealed in this particular project; it was theory-based, and conceived in a "bow tie" (broad/narrow/broad) model. It presented this opportunity as a prototype of many design opportunities, with emphasis on generalization from this experience to others. Yet the teachers consciously planned to

> hold a few things the same but change almost everything else, and have students apply their knowledge ... in a completely different situation that they've never had before

so the entire experience could be a "tremendous confidence builder." Ensuring that success and confidence would result required the teachers to judge the optimal degree of openness, unfamiliarity, and consequently challenge to students -- an open, challenging task for the teachers themselves.

Helping Students Through a Solution.-- In working with students these teachers balanced the necessary challenge of the task against the specificity the students required to "get started" and to be successful and confident. They expressed individually and also demonstrated in working with students that they will hold off transforming the assignment to specifics too early in the project, and in dealing with students they demonstrated how they defer until later the details they will ultimately need to discuss. The teachers clearly acknowledged that they do this consciously; they plan carefully to provide needed specificity at the proper moment in the students' developing work.

On the other hand, improvisation was an important feature of their day-to-day instruction, and even in the way they refined their students' projects. The improvisation described by Yinger (1987) permeated all aspects of these teachers' work. They spoke of being watchful of students nearing dangerous waters, and both also elaborated on altering the assignment for specific students when necessary. They kept before students at all times -- even when the task became the most focused -- their convictions about the power of prototypes in designing, and therefore in learning about design.

The Importance of Teacher Thinking and Planning

As this paper's introductory sections emphasized, research on teaching has only in the last two decades turned to inquire about teachers' thinking. Of the work on teachers' thinking, the majority has addressed teachers' thinking in interactive instruction; teachers' planning has received less attention. In postsecondary education, only the work at the National Center to Improve Postsecondary Teaching and Learning (Stark, et al., 1988) has addressed the elements and influences in college teachers' planning, and that research focused -- for many good reasons -- on introductory college courses taught for the most part by traditional instructional methods.

Because of professional fields' growing importance in higher education, and because in professional curricula "apprentice" instructional arrangements center on academic tasks such as design projects, this study's findings can be important beyond the specifics of the design studio, and beyond the particular teachers studied in this particular studio. The study's discoveries about how teachers' conceptual frames influence their planning, together with the study's exploration of the academic task, will extend to the postsecondary level the interesting work underway for primary and secondary classrooms. Most importantly, the study's discoveries about "openings and closings" have provided a metaphor to guide future research not only on the project assignment in professional education but on college teaching in general.

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